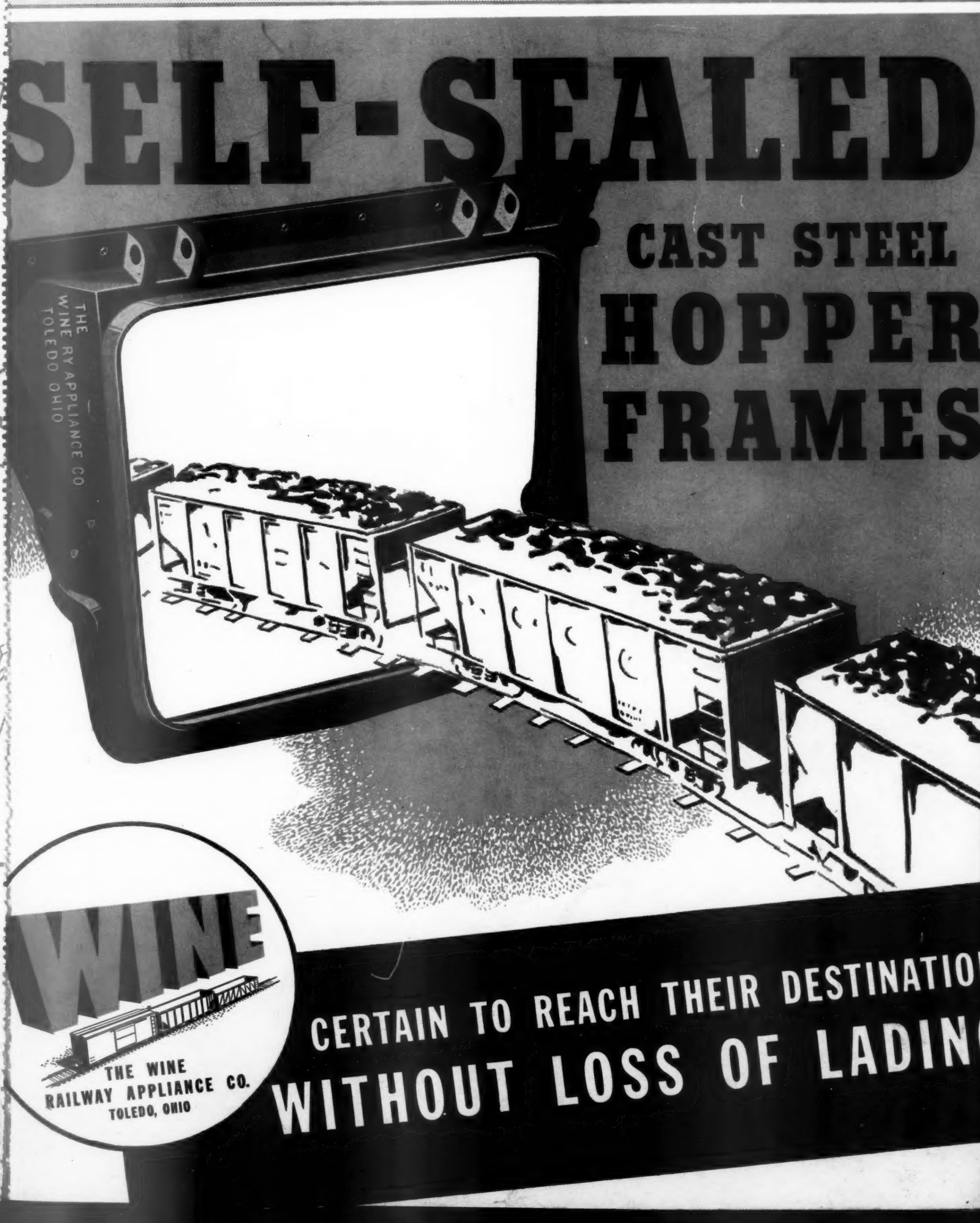
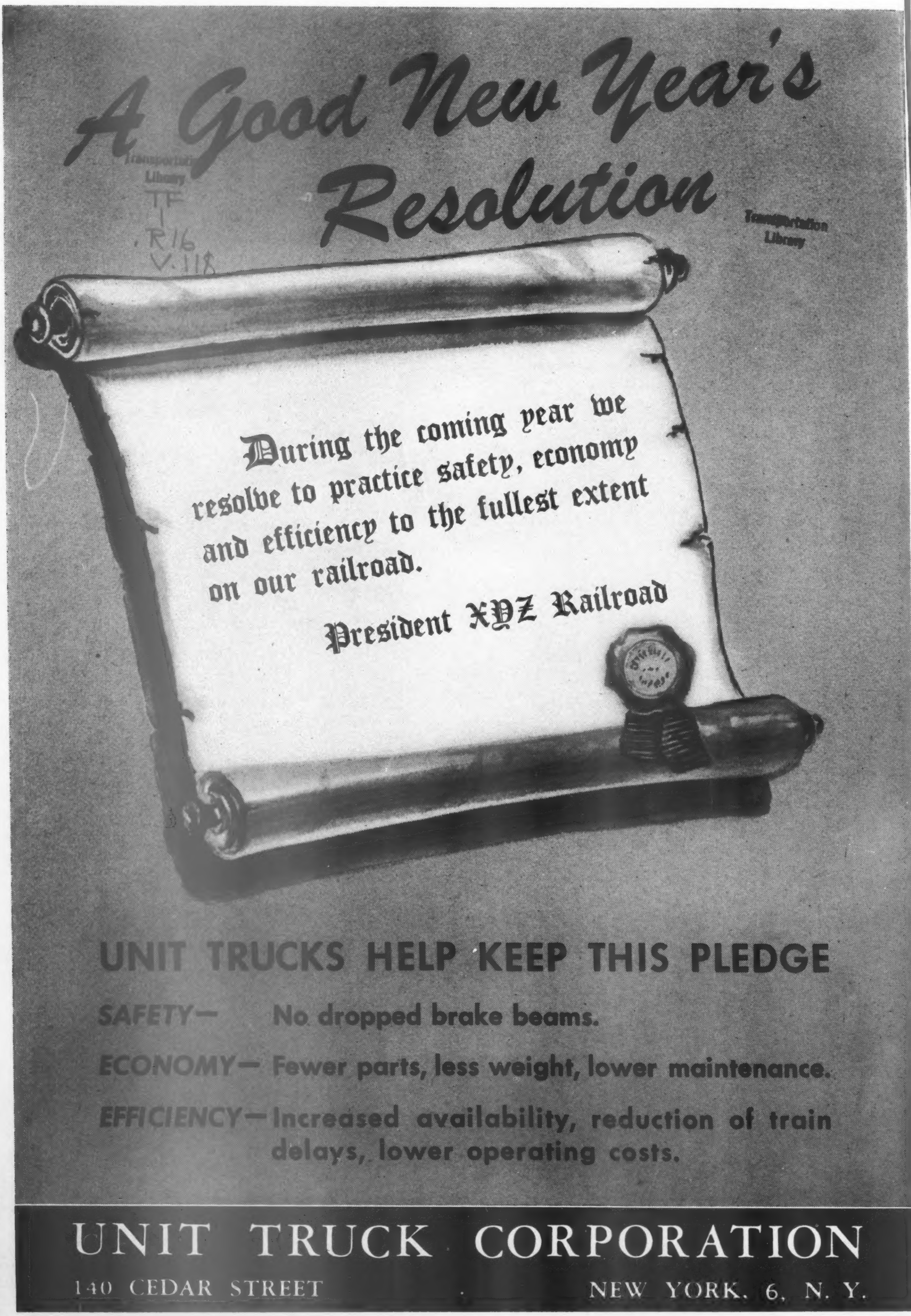
January
1944

Railway Mechanical Engineer

With which is incorporated RAILWAY ELECTRICAL ENGINEER





Published monthly by Simmons-Boardman Publishing Corporation, 1309 Noble Street, Philadelphia, Pa. Entered as second-class matter, April 3, 1933, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription price, $3.00 for one year, U. S. and Canada. Single copies 35 cents. Vol. 118, No. 1.

Transp.

RAILWAY MECHANICAL ENGINEER

(Name Registered, U. S. Patent Office)
With which is incorporated the RAILWAY ELECTRICAL ENGINEER.

Founded in 1832 as the American Rail-Road Journal

JANUARY, 1944

Volume 118 *No. 1*

A. S. M. E. Annual Meeting:

Railroad Papers at the A.S.M.E. Annual Meeting 1
A.S.M.E.-A.I.E.E. Discuss Selection of Motive Power .. 2
Postwar Passenger Cars 7
Past and Postwar Problems of Railway Research 9
Postwar Possibilities of Materials for Railroad Use 12
The Education of Engineers 15

Editorials:

System-wide Planning Needed 17
Manpower Problem Calls for Action 17
Designs Adapted to Future Needs 18
Enginehouse Betterments Demonstrate Their Worth 18
Prospects for More Locomotives and Cars 19
New Books 19

Roundtable:

Couplers and Draft Gear Maintenance 20

Car Foremen and Inspectors:

Reading Installs Paint Stripping Plant 25
Passenger Train Heating 26
Decisions of Arbitration Cases 27
Western Pacific Caboose 28
Air Brake Questions and Answers 29
Carrier for Journal Boxes 29

Backshop and Enginehouse:

Efficient Methods of Boiler Washing and Filling 30
Planer Safety Device 33
Removing Key on Wheel-Press Beam 33
Safety Suggestions 34
Questions and Answers on Welding Practices 34

Electrical Section:

Electrical Equipment for 65- and 80-Ton Switchers 35
Army Hospital Train Is All-Fluorescent Lighted 37
Lead-Coated Steel Banding Wire 37
Vulcanizing Portable Cable 38
Silver Solder Dispenser Avoids Waste 39
Floating Rides for Trains 39
Electrolytic Filter Cleaning 39
A "Wacky" Situation (A Walt Wyre Story) 40
Mobile Power Plants 43

New Devices:

Band Filer 44
Hydraulic Conversion Vise 44
Outdoor A.C. Welder 44
Self-Cleaning Drill 45
Hydraulic Jacks 45
Rotary Surface Grinder 45
Portable Fluorescent Light 45

High Spots in Railway Affairs 46

News 47

Index to Advertisers .... (Adv. Sec.) 105

***Attention!* 1943 Indexes**

Please send in your request immediately for the index. Copies are sent only to those who write for them. Those who received the 1942 index are already on the mailing list.

Published on the second day of each month by
Simmons-Boardman Publishing Corporation

309 Noble street, Philadelphia, Pa. Editorial and Executive Offices: 30 Church street, New York 7, and 105 West Adams street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D. C.; 1038 Henry bldg., Seattle 1, Wash.; 300 Montgomery street, Room 805-806, San Francisco 4, Calif.; 560 W. Sixth street, Los Angeles 14, Calif.

Subscriptions, payable in advance and postage free, United States, U. S. Possessions and Canada: 1 year, $3; 2 years, $5. Foreign countries: 1 year, $4; 2 years, $7. Single copies, 35 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

SAMUEL O. DUNN, *Chairman of Board, Chicago;* HENRY LEE, *President, New York,* ROY V. WRIGHT, *Vice-Pres. and Sec., New York,* FREDERICK H. THOMPSON, *Vice-Pres., Cleveland;* ELMER T. HOWSON, *Vice-Pres., Chicago;* FREDERICK C. KOCH, *Vice-Pres., New York;* ROBERT E. THAYER, *Vice-Pres., New York;* H. A. MORRISON, *Vice-Pres., Chicago;* J. G. LYNE, *Vice-Pres., New York;* H. E. McCANDLESS, *Vice-Pres., New York;* JOHN T. DEMOTT, *Treas. and Assist. Sec., New York.*

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.), and is indexed by the Industrial Arts Index and also by the Engineering Index Service. PRINTED IN U. S. A.

Two
during
Mecha
Decem
sponsc
Power
portat
trical
prised
a railr
road
about
road a
Dr.
presid
aftern
gram
Brigac
Involv
At
2, pre
sibiliti
use ir
out in
said th
to pro
and cl
increa
small
W.
ities.
freigh

RAILWAY
MECHANICAL ENGINEER

Railroad Papers at the A.S.M.E. Annual Meeting

Two sessions of importance to the railroads were held during the annual meeting of the American Society of Mechanical Engineers at New York, November 29 to December 3, 1943. The first of these sessions was sponsored jointly by the Railroad and the Oil and Gas Power Divisions of the A.S.M.E. and the Land Transportation Committee of the American Society of Electrical Engineers. The other session, which really comprised separate morning and afternoon sessions with a railroad luncheon between, was sponsored by the Railroad Division alone. This session was attended by about 400 and luncheon was served to about 700 railroad and railroad supply men.

Dr. Roy V. Wright, past president of the A.S.M.E., presided at the joint session, which was held on the afternoon of December 1. This brought to the program no less than seven locomotive experts to discuss Brigadier General C. D. Young's paper on "Factors Involved in the Selection of Railroad Motive Power."

At the morning and afternoon sessions on December 2, presided over by Chairman J. R. Jackson, the possibilities of new materials which will be available for use in railway equipment after the war were pointed out in an address by C. B. Bryant. Edward G. Budd said that the railroads face a great future, but will have to provide better-designed and more comfortable coaches and cheaper and faster service. He predicted greatly increased travel by air after the war, but said it will be small compared with that on rails and highways.

W. I. Cantley discussed postwar research possibilities. He predicted much wider use of lightweight freight and passenger cars; proposed a long-range program calling for the construction of 125,000 new freight cars each year for 10 years after the war; suggested the retirement of an equal number of old cars; and outlined the possibility of further improvements in motive power of all types. Dr. Wright addressed the division on the education of railway mechanical engineers for the postwar period. The Committee on Survey of the Railroad Division presented no formal report this year. In reporting progress, Lawford H. Fry, the chairman of the Standing Technical Committee on Locomotives, presented by title a paper prepared for his committee by B. S. Cain on Diesel-Electric Locomotive Ratings. This will be the basis of an article in an early issue. Mr. Fry said that progress might be expected in 1944 on the proposed handbook of formulae on locomotive design, the development of which is in the hands of his committee.

Speaking for the Standing Technical Committee on cars, Chairman K. F. Nystrom said that the intention was to develop and publish a loose-leaf handbook containing formulae and technical data on the design of railway cars, but that this project will have to be deferred until after the war. Mr. Nystrom stated that a paper on stress analysis of various important passenger-car parts has been started but that the author was unable to finish it and hopes to make substantial progress in time for a report at next year's meeting.

The papers of the two programs, with summaries of the discussions, appear on the pages immediately following. Elsewhere in this issue will also be found an announcement of the new officers of the Railroad Division.

• • •

Selection of Motive Power*

By Brig.-Gen. C. D. Young
(U. S. A. Retired)†

A consideration of a variety of factors and the proper weighing of each is important in arriving at a decision as to the type of power to use

THE factors that should be considered in the selection of railway motive power must be weighed carefully to arrive at a sound conclusion. Some of these factors are of interest to the president and to the board of directors, whereas others primarily concern engineering and operating officers in the management group.

The more miportant factors which should be given consideration are:

1—The density of traffic per mile of road and the territory in which the locomotives are to be operated initially.

2—As a corollary, it is important to consider, also, the density of traffic over the heavy rails in the operation of full-tonnage trains.

3—The capital cost of alternative types of power, including the cost of lot sizes of steam locomotives and the availability of funds at the time of purchase.

4—Crew wages and rules affecting cost of runs for locomotives of various types and various tractive force capacities.

5—The time required for initial delivery and completion of the lot order.

6—The cost of maintaining and servicing various types of motive power appropriate to each other and to the operation to which they are to be assigned.

7—The probable maximum availability of the various types of locomotives (steam, electric, Diesel-electric) in service, measured in hours per day, week or month.

8—As a corollary of the above, a determination of the time required for servicing different types of power, and of the possible need of additional facilities to service a new type of motive power.

9—The cost of fuel (coal vs. petroleum) or electricity at the time of purchase, and the outlook for the cost of the future supply.

10—The thermal efficiency of the fuel, where thermal efficiency is involved in the type selected.

11—Desired novelty in design or type to attract public attention to the new motive power installed, to publicize the innovation.

12—Relative obsolescence rate of the various types of power considered and possible disposition by relegation to less important service or sale.

These are the major factors which should be weighed. I will confine my remarks to two factors: namely, the density of traffic—primarily of road and territory in which the locomotives are to be operated—and the initial capital cost. I do this because a number of the other factors enumerated could be discussed more appropriately before other engineering group meetings rather than before one covering such a wide and diversified field as do the joint Societies present here today.

[At this point the speaker referred to a chart which had been prepared by the Office of Defense Transportation showing the traffic density of roads in northeastern United States for the year 1929 to illustrate the necessity of considering this factor in the long-range planning for motive power selection. He also pointed out that surplus capacity of hydro-electric power generating stations, in the post-war period, may make available electrical energy at low cost, particularly in the West, which may influence electrification.—EDITOR]

It is important in a discussion of cost as a factor in choice among alternative types of locomotives to review the gross capital expenditures for motive power by the railways of the United States during the six years ending with 1942, the latest year for which figures are available. The total sum spent from 1937 to 1942 amounted to 391 million dollars, and this sum represented 25 per cent of the gross capital expenditures by the carriers during those years for all estimated needs. Sixty-two per cent of the period total was expended for freight cars and the remainder for trackage, communication and signals, and miscellaneous requirements. The average annual outlay in this period for locomotives was 65 million dollars; the smallest expenditure was in 1938 when 40 million dollars were spent, and the largest amount expended was 114 million in 1942. This is a sizable sum and stresses the importance of discussion on this third factor, the unit cost of the locomotives acquired through such capital expenditure.

It is impossible that, had it not been for war—first threatened and then realized—so great a sum as 391 million dollars would have been spent upon motive power in the years 1937 to 1942, inclusive. The figure does give an idea of the importance of locomotive unit costs and indicates the significance of seeking in every possible way to discover methods of reducing those costs—in the interest of both builder and buyer.

It does not seem appropriate to discuss the actual financing problem of such a sizable sum and the relation of the unit cost of the locomotive to favorable equipment trust terms and conditions. Further, you all know as well as I the various major charges that enter into the cost of manufacturing, including a fair profit, so I shall make no mention of them. I shall, in fact, confine my remarks to but a single factor, and a most important one, which seriously affects the cost of manufacturing—the lot size of an individual or a group order for a particular locomotive. These lot sizes are determined fundamentally by customer judgment of need;

* Abstract of an address made before a session of the annual meeting of the American Society of Mechanical Engineers sponsored by the Railroad and Oil-Gas Power Division of that society and the Committee on Land Transportation of the American Institute of Electrical Engineers, held at the Hotel Pennsylvania, New York, December 1, 1943.

† Deputy director, Office of Defense Transportation.

Table I—Principal Characteristics of Steam Locomotives for Class I Railroads from October 1, 1942, to September 30, 1943, Inclusive

Builder	Railroad	No. built	Wheel arrangement	Weight of engine, lb.	Combined heat. surf., total sq. ft.	Cylinders, diameter and stroke, in.	Maximum tractive force, lb.
merican	B. & L. E.	4	0-8-0	279,000	3,931	25 x 30	64,300
ima	C. & O.	8	0-8-0	244,000	3,237	25 x 28	57,200
aldwin	L. & N.	6	2-8-4	447,200	6,562.3	25 x 32	65,290
ima	N. Y. C. & St. L.	10	2-8-4	421,000	6,704	25 x 34	64,100
ima	R. F. & P.	10	2-8-4	433,200	6,704	25 x 34	64,100
aldwin	B. & L. E.	2	2-10-4	524,440	8,278	31 x 32	96,700
enna.	Penna.	85	2-10-4	578,000	9,498	29 x 34	95,000 + 15,000 booster
. & W.	N. & W.	15	2-6-6-4*	573,000	9,342	24 x 30	114,000
ima	C. & O.	9	2-6-6-6*	724,500	10,426	22½ x 33	110,200
. & W.	N. & W.	5	2-8-8-2†	582,900	7,422	25 and 39 x 32	152,206 (126,836 compound)
aldwin	D. M. & I. R.	10	2-8-8-4*	699,700	9,528	26 x 32	140,000
ll. Cent.	Ill. Cent.	20	4-8-2	423,893	6,830.2	28 x 30	83,160
ima	N. Y. C.	25	4-8-2	397,300	6,779	26 x 30	59,900
ima	Cent. of Ga.	8	4-8-4	437,800	6,420	27 x 30	62,200
merican	D. & H.	15	4-8-4	470,000	5,950	24½ x 32	62,040
aldwin	Mo. Pac.	15	4-8-4	489,000	7,506	26 x 30	67,200
merican	N. C. & St. L.	4	4-8-4	399,000	5,924	25 x 30	57,000
aldwin	Nor. Pac.	10	4-8-4	508,500	6,602.7	28 x 31	69,800
aldwin	R. F. & P.	6	4-8-4	408,400	5,619	27 x 30	62,800
aldwin	St. L.-S. F.	21	4-8-4	462,500	6,274	28 x 31	71,200
t. L. S. W.	St. L. S. W.	5	4-8-4	425,500	6,686	26 x 30	61,564
ima	So. Pac.	10	4-8-4	468,400	6,938	27 x 30	64,200 + 11,300 booster
ima	West. Pac.	6	4-8-4	466,100	7,008	27 x 30	64,200 + 11,300 booster
merican	Clinchfield	8	4-6-6-4*	607,000	7,072	22 x 32	101,120
merican	D. & H.	15	4-6-6-4*	597,000	7,070	20½ x 32	94,400
merican	D. & R. G. W.	6	4-6-6-4*	630,000	6,957	21 x 32	97,350
merican	No. Pac.	12	4-6-6-4*	644,000	7,854	23 x 32	106,900
merican	U. P.	25	4-6-6-4*	633,500	6,957	21 x 32	97,350
aldwin	So. Pac.	30	4-8-8-2*	657,900	9,096	24 x 32	124,300

* Simple. † Compound.
(Note—Prepared by Division of Materials and Equipment, O.D.T., from information furnished by Division of Railway Transport of O.D.T., Transportation Equipment Division of W.P.B., and locomotive builders.)

nevertheless, such judgment normally is strongly influenced by the individual engineering originality of the chief of the mechanical organization of the purchaser, as well as by the activity of the locomotive builders and locomotive specialty concerns—these, through sales organizations, urging individual designs intended to give them a favorable competitive position with prospective customers.

Purchasers of Steam Power Are Individualistic

The marked individualism characteristic in locomotive purchasing as displayed by both buyer and seller is well illustrated by the specifications of locomotives built in the twelve months, October 1, 1942, to September 30, 1943. The chief characteristics of those locomotives appear in Table I. As you will observe, this record covers steam locomotives only. A high degree of standardization of other types of locomotives, both Diesel-electric and electric, has been developed in recent years; with these, variety of design is not great. They are generally built on the production line.

Looking at the chief characteristics, you will observe that in wheel arrangement alone a wide variety of design was purchased. One hundred and seventy units were of the 2-8-2 or 4-8-2 or 4-8-4 type; 87 units were 2-10-4's; 90 were 2-6-6-2 or 4-6-6-2 or 4-6-6-4's, simple; 40 were 2-8-8-2 or 4-8-8-2 or 4-8-8-4's and the 18 others, of 405 built, were miscellaneous. Of the largest lot noted above the group of 170 units having eight drivers, 100—almost 25 per cent of the total—were 4-8-4's and these were, with the exception of five, purchased by 10 railroads from three builders. These five were built in a railroad shop in accordance with the designs of one of the builders.

In wheel arrangement these 100 locomotives are similar, but there similarity ceases, as is so clearly shown in the Table II. In this table, I have listed only this group of 4-8-4's, showing separately the characteristics of each of the ten lots. In the preparation of this table it was my purpose to determine whether the number of different designs with the same wheel arrangement could be substantially reduced. I believe that such reduction is possible, yet the need of each of the railroads be met. Indeed, it appears that such need might be met by two designs instead of 10, thus making potentially possible decreased manufacturing costs.

You will observe that as to axle load, there is a 65 per cent variation between the minimum and maximum, when average axle load is compared with the average weight of rail per yard in the case of each railroad. Undoubtedly, bridge strength and condition are in part responsible for this variation. On the other hand, it is evident that full advantage of rail strength has not been taken

Table II—Variations in Characteristics of Type 4-8-4 Steam Locomotives Built from September 1, 1942, to September 30, 1943, Inclusive

Railroad	Weight of engine, lb.	Average weight of rail, lb. per yard	Average weight on axle, lb.	Average axle load per average weight of rail, lb. per yard	Evaporative heat. surf., sq.ft.	Grate area, sq.ft.	Sq. ft. heat.surf. per sq. ft. of grate area	Diameter of drivers, in.	Cylinders, diameter and stroke, in.	Cylinder displacement per mile—million cu. in.	Sq. ft. heat surf. per thousand cu.in.cylinder displacement per mile	Steam pressure, lb. per sq. in.	Maximum tractive force, lb.
A	489,000	88	69,800	793	5,306*	106.0	50.1	73	26 x 30	17.6	302*	285*	67,200
B	508,500	88	73,800*	838*	4,672.7	115.0*	40.6†	77*	28 x 31	20.0	234	260	69,800
C	408,400	129*	65,800	510†	4,294	86.5	49.6	77*	27 x 30	18.0	239	260	62,800
D	462,500	87	70,000	805	4,766	88.0	54.2	74	28 x 31	20.8	229†	255	71,200*
E	425,500	84	62,000	738	4,724	88.3	53.5	70†	26 x 30	18.4	257	250	61,564
F	470,000	102	67.500	662	4,477	96.2	46.5	75	24½ x 32	16.2	276	285*	62,040
G	399,000	90	57,000†	633	4,203†	77.3†	54.4	70*	25 x 30	17.0	247	250†	57,000†
H	437,800	83†	64,500	777	4,707	90.4	52.1	73½	27 x 30	18.9	249	250†	62,200
I	468,400	97	70,800	729	4,852	90.2	53.8	73½	27 x 30	18.9	257	260	64.200‡
J	466,100	98	70,300	717	4,922	90.2	54.6*	73½	27 x 30	18.9	260	260	64,200‡
Variation between minimum and maximum, per cent				64.3	......	......	34.5	10.0	......	....	31.9	14.0	24.9

* Maximum. † Minimum. ‡ Booster tractive force, 11,300 lb., not included.

by some of the railroads in fixing upon the tractive force and weight on drivers of locomotives purchased. To illustrate, Railroad C, with an average weight of rail per yard of 129 lb., has been satisfied to secure locomotives with little greater traction force than that of locomotives purchased by Railroad H, with an average weight of rail per yard of 83 lb.

In drawing your attention to the next variation, it would be better in making this comparison if data had been available of a drawbar pull-speed curve rather than making a comparison of tractive force. However, merely as illustrative of the wide difference between locomotives of substantially the same hauling capacity, it is to be observed that there is a variation of 34 per cent in the ratio of grate area to total evaporative heating surface and, curiously enough, that the tractive force of the locomotive with the highest ratio of heating surface to grate area, Railroad J, is less than the locomotive with the lowest ratio, Railroad B. This suggests that so far as the boilers of the 10 different locomotives built are concerned, there is little relationship in the designs between the hauling capacity, boiler capacity and grate area, and although one would expect to find some variations due to the characteristics of the roads over which the locomotives are to operate, and the character of the fuel, there should not be such violent differences as are seen here. This points to the next ratio analysis.

Upon the basis of computations made, it appears that there is a variation of 31.9 per cent in square feet of heating surface per million cubic inches of cylinder displacement per mile of operation, and that variation between the minimum and the maximum of the 4-8-4 locomotives is between design A and D in the higher tractive capacity group. It appears further that the locomotive with the greatest tractive capacity, that purchased by Railroad D, has the lowest heating surface in relation to cylinder and driver size, and this is compensated for only in part by the higher boiler pressure and maximum heating surface to supply the cylinders of the Railroad A locomotive.

Two Designs Would Have Sufficed

Many other comparisons could be offered, but these emphasize the variations sufficiently, I believe, and raise questions as to their economic justification. While this discussion is in no sense a criticism of any particular one of the designs, it does seem there was little warrant for the wide variations shown. These 100 locomotives might well have been built to two designs, I believe, had the matter of design been reviewed carefully by those especially qualified and had there been a genuine determination on the part of these engineers to reduce the manufacturing cost through standardization. In one group might well have fallen the locomotives built for roads A, B, and D, locomotives of high tractive force; in the other, those of medium tractive force built for the other roads. Certainly, if two designs could have been substituted for the 10, the unit cost per pound of producing these locomotives would have been materially less and manpower saved.

If a considerable number of locomotives of a single design are ordered, construction can be put upon a production-line basis. Furthermore, standardization will permit material reductions in machining costs, for then the builder will be justified in acquiring specialized tools to produce particular parts of the locomotive, even though the capital outlay for such tools may be heavy. The advantage here is clearly evidenced by the machine-tool practices of the Diesel-electric builders using special and automatic tools. With standardization of design should be developed also standardization in specifications for materials entering into locomotive construction, as these have an effect upon both inventory of manufacturers and final cost to them.

A Needless Handicap to Steam Power

If the steam locomotive is to continue to hold its "place in the sun," it should not be handicapped in competition with those other forms of heavy traction units which have come into general use. Yet, in an era of mass production, the steam locomotive now finds itself so handicapped, despite its magnificent past performance and handicapped needlessly in part. Is it unreasonable to suggest that the individualism of engineering involved in buying and selling steam locomotives be kept within such limits that this type of power may be adapted in considerable degree to mass production and thus benefit from the lower cost which will result? Competition among steam locomotive specialty manufacturers has also tended to encourage the continuance of custom manufacture of steam locomotives; they should recognize the danger of excessive individualism in locomotive building, just as builders and carriers ,and they should seek to put the manufacture of specialties upon a mass production basis, just as designers should seek to do for the complete unit. The friends and champions of the steam locomotive can do much to aid it in maintaining an important place upon the railroads of the United States.

Will they make the minor sacrifices, take the effort requisite to attain that major end?

I hope this discussion may be fruitful of further thought. It is a most important subject. It is one of the factors that seriously affects the future of the steam locomotive, namely, its ever-increasing poundage cost and horsepower cost against the competition of electric and Diesel-electric locomotives.

Discussion

P. A. McGee (Electro-Motive Division, General Motors Corp.): Calling attention to the fact that the paper was concerned primarily with heavy density traffic requiring special types of motive power, Mr. McGee said there are numerous other factors controlling the selection of locomotives. Among these he said are motive power units which can be used anywhere on the line or on parallel roads when it is necessary to divert traffic. This question involves axle loadings and in the case of electric locomotives, the type of contact system used.

Coal, oil and power requirements of the railroads are shown in Tables III and IV. In connection with these tables Mr. McGee stated:

"Tables III gives the total freight, passenger and switching services performed together with unit fuel and power consumption values for the year 1942 with steam, electric and Diesel power. The steam power is divided into coal-burning and oil-burning power.

"Starting with freight power, it will be noted that there was a total movement including locomotives and tenders of 1,700,750,000 gross ton-miles of which the steam coal power produced over 78 per cent, steam oil 19 per cent, electric power 1.8 per cent, and Diesel power less than 1 per cent. The use of Diesel freight power in 1942 was quite limited and the values shown are estimated.

"With passenger power there was a total movement of 3,491 million car miles excluding multiple-unit trains,

f which steam coal power produced 61 per cent, steam l over 23 per cent, electric power 6.6 per cent, and iesel power 8.8 per cent.

"With switching power there was a total of 53 million witching hours of which steam coal produced 72 per ent, steam oil 12 per cent, electric power 1.3 per cent, nd Diesel power 14.7 per cent.

"With the increase in the use of Diesel freight power 1943, there is now a representative amount of the hree types of power in operation to permit an accurate stimate of the advantages and economies which may e expected under the varying conditions existing in he United States.

"The unit values of fuel and power consumption hown in Table III for the three types of service for

able III—Class I Railroads—Freight, Passenger and Switching Services Performed and Unit Fuel and Power Consumption Values Year 1942 with Steam, Electric and Diesel Motive Power

	Steam power				
	Coal burning	Oil burning	Electric power	Diesel power	Total
reight, 1,000 .t.m. incl. loco.	1,330,694	324,592	31,958	12,506[1]	1,700,750
reight 1,000 g.t.m. s per cent total	78.3	19.1	1.8	0.8	100
uel and power er 1,000 g.t.m.	113 lb.	8.2 gal.	28.2 kw. hr.	2.0 gal.	......
assenger, million ar miles	2,136	816	230[2]	309	3,491
assenger, million car miles as per cent otal	61.0	23.6	6.6	8.8	100
uel and power er car miles......	17.0 lb.	1.01 gal.	3.6 kw. hr.	0.27 gal.	......
witching, million ours[3]	38.2	6.4	0.7	7.8	53
witching, million hours as per cent total	72.0	12.0	1.3	14.7	100
uel and power per switching hour ..	782 lb.	58.2 gal.	112 kw. hr.	5.7 gal.	......

Note: Above values from A. A. R. Bureau of Economics
[1] Estimated value
[2] Includes locomotive hauled trains only
[3] Switching terminal companies and industries omitted

Class I railroads represent perhaps the most significant ndex of power performance.

"Diesel power in switching services consumes about ne-tenth the amount of oil fuel with steam power or little over one-twentieth the amount by weight of coal. For road services Diesel power consumes less than one-uarter the amount of oil fuel used by steam power r one-eighth the amount by weight of coal power.

"Table No. IV shows the unit fuel and power consumption values of Table III converted into total values f fuel and power for 1942. In the last column I have iven an estimate of the total fuel which the Class I ailroads would have consumed had all the services onsidered been operated with Diesel power at the unit alues of Table III.

able IV—Class I Railroads—Summary of Fuel and Power Consumption Year 1942 with Estimate of Fuel Consumption with Complete Diesel Operation

	Steam power			Diesel power	
	Coal, tons	Oil, gal.	Electric power, excl. m. u. trains kw.-hr.	Year, 1942, gal.	Estimated with complete operation, gal.
reight service in millions	75.3	2,670.9	902.2	25.0*	3,401.5
assenger service in millions	18.2	828.0	818.6	84.0	943.0
witching service in millions	14.9	347.1	80.2	44.6	302.5
otal of above in millions	108.4	3,846.0	1,801.0	153.6	4,647.0

* Estimated

"One of the interesting facts shown in Table IV is that the power output as measured by fuel consumption of the 200-odd Diesel road passenger locomotives is about twice that of the 1,000-odd Diesel switching locomotives, the consumption of the former being 84 million gallons against 44.6 million gallons for the switchers.

"The most interesting fact, however, shown in Table IV is that the 1942 consumption of fuel oil on the Class I railroads was practically 4,000 million gallons and the estimated total fuel requirements with complete Diesel operation for all services considered is 4,647 million gallons. In other words, the present fuel oil consumption in our Class I railroads is over 85 per cent of that which would be required with complete Diesel motive power operation.

"Diesel motive power on our railroads would, therefore, appear to offer one of the most attractive conservers of our fuel resources."

S. T. ROBINSON (Wright Aeronautical Corp.): I have been asked to express my views, as being one associated with the aircraft industry, regarding lightweight high output locomotive equipment. This field is entirely new to us but I find that your requirements for equipment do not differ greatly from those of airlines in that you want a power unit having a wide operating range with ample reserve power capacity installed in as light a locomotive as is compatible with tractive requirements.

In order to give you a picture of how a locomotive could be designed using gas turbine power plants, I have gathered a small amount of data describing a 6,000 hp. locomotive intended for main line passenger and freight service.

The locomotive would consist of a single 6,000 hp. unit; capable of a short time overload rating of 9,000 hp. The operating cab would be in the center in which would be contained an auxiliary engine, air compressors, a boiler for train heating, and other equipment. Two gas turbine power plants would be used, one under the front hood and one under the rear hood. Portions of these hoods would be readily removable to permit easy removal of the power plants.

The wheel arrangement would be 4-8-8-4. All axles would be driving axles and all wheels would be the same size. The gross weight of the locomotive would be 600,000 lb., thus giving an axle loading of 50,000 lb.

Sufficient fuel and water would be carried in the locomotive in tanks under the operating cab for a 400-mi. trip. If it was desirable to increase the operating range additional supplies of fuel and water could be carried in a tender.

Each of the 12 driving axles would be fitted with a d. c. traction motor of 750 hp. However, the two turbines would drive individual direct connected alternators. It would be necessary to rectify the a. c. supply for the d. c. traction motors and while such a system would be high in first cost this cost should be balanced against the saving in weight of the generators, the space requirements and the reduction gearing that would be necessary if a d. c. generator were used.

L. H. FRY (Locomotive Institute): It is not my intention to do any special pleading for any one type of motive power. All three have their characteristics and their own place in the economy of the railroads. As engineers it is our job to appraise and determine the conditions under which each must be selected.

A discussion such as the present brings to our attention certain features of the different motive power systems, but actual choice of type must be based on more extended study. Consideration must be given to all of the interrelated conditions which obtain in the terri-

tory which is to be operated. If a real answer is required, the problem must be broader than the performance of a group of locomotives to be purchased new and put into operation alongside of many older locomotives. Under such conditions it is normal for the new group to take the cream of the traffic. The older power is drawn on for protection and helper service and the new group hangs up an excellent record. This is true of steam and Diesel. Another group of power of the same kind put into service at a later date will find that the cream is a little thinner and that some of the easy money is gone. The law of diminishing returns takes its toll.

When new power is under consideration, choice should be based, not on the record of a few locomotives in selected service, but on the effect that will be obtained when the locomotives have been assimilated by the road and have been in service long enough for true maintenance and depreciation figures to be known and used. Attention should also be given to traffic conditions and their effect on the utilization of power. If the traffic calls for an 18-hour run with a six-hour lull before return traffic starts to move, there is little advantage in being able to turn a locomotive in half an hour. In this connection it may be pointed out that before giving percentages of availability for different locomotives the term "availability" should be defined. The real value of availability is in relation to use. It seems proper to define availability as the time the locomotive stands ready for service expressed as a percentage of the time during which it can be used. Availability without utilization earns no dividends. The railroad manager is interested in the commercial availability.

E. G. Bailey (Babcock & Wilcox Company): Fuel is largely the source of power. It may prove to be short-sighted to expand forms of power that are limited to certain kinds of fuel beyond the point where the supply of such fuel can be economically assured. Coal has many characteristics which lead to discouragingly low efficiency, work and dirt, but to a large extent these limitations have been overcome, especially in large central stations and industrial plants with stationary boilers. Coal is still the basic fuel of this country. It may take no more research or inventive genius to develop other forms of motive power adapted to the use of raw coal that will surpass everything known or even dreamed of; it may require only another viewpoint, a different state of mind and a determination to chart a new course in a different direction to find the best, simplest and most economical power for our railroads.

I still have faith that a satisfactory method can be found to use raw coal as the long range answer to the motive power problem.

A. I. Totten (General Electric Co.): In the selection of motive power, there are two important considerations of a fundamental nature, namely (1) The character of the work that each type is capable of performing; (2) The operating expenses and other charges appertaining thereto.

The controlling factors, on any railroad, comprise the elements of track capacity and time. These, in turn, are affected by the number of tracks involved, the volume of traffic, the arrangement of sidings, the grade conditions and the speed limits.

We are therefore forced to the conclusion that improvement in operation with the resultant traffic benefits, constitutes the prime reason for electrification and Diesel power in road service, whereas in switching service the Diesel locomotive reigns supreme as an economical motive power unit.

Irrespective of capital investment considerations, seems safe to state that either electric or Diesel-electr locomotives can produce a given volume of work at lower operating expense than possible with the existin steam locomotives.

From a combined investment and operating expen standpoint and disregarding advantagous features th cannot be readily capitalized, electrification can be just fied for a relatively dense traffic movement subject t variable factors dependent upon extraneous condition

The Diesel-electric locomotive overall economy is in fluenced, in a large degree, by the application of trai schedules that will permit of a large annual mileage ove which the fixed charges can be distributed.

Whether or not it will be economically sound t abandon steam operation, wholly or in part, depends upo many elements, prominent among which are the age o the steam locomotives, the prevailing financing costs, fue prices, etc. All of these factors will affect the real sav ings that can be made.

N. Litchfield (Gibbs & Hill): When the capital cost of electrification are under consideration, an analysi should be made of the composition of these costs.

Existing electrifications have come into being to ac complish definite purposes, for instance, a higher sched ule speed. This necessarily involves an increase in maxi mum speed and necessitates, among other things, a dif ferent spacing of signals. In this change, one is apt to find that the railroad has obtained a new and much im proved signal system. Other similar improvements fol low, all charged to electrification, whereas, strictly speak ing, they should be charged to improvement.

If the higher schedule speed is to be obtained with some other form of motive power, it should not be for gotten that the road may be involved in attendant im provement costs and hence it is not fair to compare the cost of some particular form of locomotive with elec trification without adding the cost of other improvements

Gen. Young spoke of the amount of electric generating capacity that will be available after the war. It is quite possible that an attractive power rate may be obtained for electrification and this should open up new possibilities for electrification. It seems quite possible to eliminate high tension transmission lines owned and operated by the railroad and to reduce the number of supply points, all through the use of a higher voltage trolley than any now existing.

Therefore, in comparing different types of motive power it is well to remember that where the traffic density is great, the electric locomotive will do all and more than any other type of motive power; that the cost of attendant improvements must be included for all type of motive power; and that improvements and economies in the cost of electrification are well in sight.

A. H. Candee (Westinghouse Electric & Manufacturing Co.) said that one cause of confusion as to the best type of motive power is the tendency of some manufacturers and mechanical officers to assume fixed opinions as to the superiority of one type of power and the reluctance to recognize radical changes now under way in the development of prime movers. Mr. Candee dealt at some length with the advantages of existing types of motive power and touched upon the developments in electric, Diesel-electric and steam turbine units that may be expected. In concluding his remarks he said that the builders are faced with a serious responsibility to the railroads; they must not only lead the way in the development of advanced designs but they must discourage the pre-war builders from building individual designs of varying specifications.

Postwar Passenger Cars*

By Edward G. Budd†

Wartime travel by millions of our citizens will create the desire to go places after the war—New equipment and low fares will help roads cash in

It has become quite the habit to think only of war materiel. However, when we consider the large expansion of our plants, the great number of men employed and the returning men and women of the armed forces to whom we owe so much, it is a matter of duty for us to lay plans to meet the peacetime problem.

Our companies, while still fully occupied in meeting the requirements of the government, feel that it is necessary to attend to the incidents of war stoppage. The writer, together with a small group of his staff, is devoting an increasing amount of time to this problem.

One of the most promising pieces of business we have relates to the railway passenger car. It is our belief that there will be an extraordinary amount of passenger travel as soon as there is a suspension of fighting. The desire to travel will manifest itself on the railroads, on the highways, and in the air. Many people will use the air, and the airways will have a flood of travel; but the air passenger mileage will be small compared with that on the rails and on the highways.

We, in this division of the American Society of Mechanical Engineers, are interested mostly in the railway travel. A victorious people will have visions and will dream dreams. Their geography has been vastly expanded by the news of the war. Their sons, relatives, and even their daughters, will have seen strange places and will come home with stories which will arouse the curiosity of the family and inspire all of us to go and see those places with our young people, so that we older folks can catch the vision which the young people have gotten in their strenuous experiences in out-of-the-way places. The government has transferred our youth from camp to camp for the various types of training. The desire to travel will be there. How will we meet it?

The reduction of time which is made possible by faster trains, and the reduction of the cost of travel, will be a dual incentive to make trips which would otherwise never have been even contemplated. I recall my surprise at learning what a difference speed and expense could make when two young scretaries in our company decided to take their two weeks' vacation in a visit to California. My first reaction was, "How outrageously extravagant! Why, these young women would be put to all the expense and would see very little of California." I found that the cost of the round trip was only about $100, and that, by working in three Sundays, they were able actually to have eight days on the Coast. These young women were quicker than I to appreciate the benefits of more rapid travel and a cheaper one. They made their trip on the newly established "El Capitan," and this train made the same fast time that the luxurious "Super Chief" did.

It is easy to project a picture of what would happen if a fine fleet of trains could be put in the Boston-New York service, making the run in three and one-half hours instead of in four and three-quarters hours, and offering a splendid coach accommodation for a little less than $5.00. The saving of two and one-half hours in the round trip would enable the traveler to return the same day. Most Boston people stay home and New York people do not go to Boston, except on unusual occasions, but a proper service would induce women to go to New York or Boston for lunch, or to go calling or shopping or to the theater, and get back to their homes on the same day. This trip between cities becomes inexpensive when the reserved seat can be gotten for coach fare, and hotel bills are saved. Long trains could go every hour. An increase of 500 per cent in this travel is a reasonable estimate. The Florida service mentioned showed an increase of 1,200 percent in coach travel after one year of operation.

The railways have earned and received great praise for the way they have handled the war situation. Nevertheless, it has been obvious to the traveler that in many cases he has been carried by vehicles which lack the charm and comfort that are possible nowadays. It is the belief of our company that many additional cars will be needed and that many new trains will be put into service so as to give more frequent times of departure and to give earlier times of arrival.

The railroads carried through one of their great accomplishments between 1905 and 1915 in building a large number of railway passenger cars of steel—fireproof, strong, and with what were considered comfortable seats and comfortable surroundings, in that day. There has not been much improvement in these particulars since that time. Just before the war there were certain trains introduced in the East, in the West and Middle West, which elevated the standard of railway coaches by taking advantage of the advance in the arts in the preceding 30 years.

Car Structure and Materials

It is conceivable that the first bread made by man was not very appetizing. Yeast and salt were the alloys which were lacking in the flour. Early iron lacked its alloys, also. The arts of this century have used metals for the making of almost everything, and 40 years ago we became conscious of the fact that the good soft, ductile iron lacked something. Then came more intensive study of alloys, and step by step steel was improved until it was many times as strong, until it resisted corrosion, was ductile and elastic. These steels were incorporated in major parts of machinery and made possible the development of many of the machines that are familiar to all of us, particularly the bicycle, and later the automobile.

* Abstracts of an address before the American Society of Mechanical Engineers, Railroad Division at the annual meeting, New York, December 2, 1943.

† President, Edward G. Budd Company.

Almost all these materials attained their best qualities by what was known as heat treatment. When our company began the study of the railway passenger car, our problem was how to get these superior qualities of metal in its structure so as to reduce the dead weight and increase the collision strength of the car. It is impossible to heat-treat so complete a structure as a railway car. It is difficult to heat-treat even the parts of the car before assembly.

We chose as our structural material a stainless steel which gets its great strength, along with its ductility and resistance to fatigue, through cold rolling. We can have the material finished in the rolling mill to a predetermined tensile strength and with other physical qualities. This material, when cold-rolled to a tensile strength of 150,000 lb. can be formed to required shapes and united by welding into a complete structure; thus giving in strength the quality that exists in an automobile chassis, without the distortion which would result from heat treatment of the framed structure. Up until now I believe no other material has been produced which is comparable, and we will continue to use it.

This assures a vehicle which can retain all the strength of a 160,000-lb. coach and weigh but 100,000 lb. This pleases the railroad operator. It results in economy of operation as well as in safety for the passenger.

It so happens that the material has a beautiful color, with greater resistance to corrosion than even silver or gold. It needs no painting to protect it from the atmosphere. Dust and dirt can readily be wiped off of it. The beauty of the trains made up of stainless-steel cars is in itself a commercial asset to the railroad. It is attractive to the prospective rider and adds to the esprit de corps of the train crew by giving them something to be proud of.

One of the factors in encouraging travel is the lapse of time from here to there. With these new trains, acceleration and deceleration take place quickly at the stations, thus saving some minutes at every station along the route. It is possible, with this kind of equipment, to make more rapid speed, but it is also possible to get from station to station in a shorter time without excessive high speeds.

So much for the actual saving of time by the clock. There is another time saver. The trains which the roads will use after the war will be so comfortably furnished in such restful colors, with pure air of right temperature, the service from railroad officials so courteous, that the time in transit will pass quickly in the mind of the passenger, and the travel from one place to another, instead of being something to dread, will be a thrilling sense of pleasure.

Generally, we men folks travel for business and only when we have to, and generally our companies pay the cost. Travel has been expensive and we have not expected to enjoy it. When, however, the public starts to travel, price will become a factor, and it is from the public that the railroads will receive their increased business.

A trip from New York to Los Angeles, Calif., with the usual layover in Chicago, takes 64 hours on the extra-fare trains, and 85 hours on the other trains. The fare and lower berth on the faster trains is $263.62 for the round trip, and very few people can afford it.

After the war, we hope that there will be other trains from New York to Los Angeles or San Francisco in 50 hours, and at a cost for fare, meals, etc., of about $70. These trains would carry 500 people and would consist of 10 sleeper-coaches, would yield the railroad $10 per mile gross revenue, and would save the passenger 30 hours in reaching his destination.

This sort of service would have an enormous appeal to the great mass of the American people, and it is from them that the railroads expect and must seek their business. Of course, luxury travel will be continued, but it can never be promoted to much greater volume than we have had in the past. The other possibility is almost limitless.

An all-sleeper-coach train service was first tried by the Santa Fe, and Samuel T. Bledsoe, wanting to assure himself of whether or not the enterprise was a promising one, asked some of his office force to discuss the project with their own families. Such a train, the "El Capitan," running from Chicago to Los Angeles, would save the passenger $40 as compared with the lower berth in the sleeper, and Mr. Bledsoe pointed out that they would have to sleep in a reclining position and would not have a bed and bed covers. One official came in the next morning and said that his wife had emphatically claimed she would sit up every night the whole year round to save $40. The train was bought, has been expanded in capacity, and now has been in operation for six years.

Of course, the automobile people also are ambitious, and they are sure to get a great share of passenger traffic. The airplane people, too, are ambitious. They offer comfort and they do save time. They have small units which can depart at frequent intervals, and they will naturally have a large expansion in the volume of their future business.

But the railroads need not fear this competition. With the development of the arts in recent years, and with the application of these new arts to the building of future railway equipment, there will be a tremendous expansion in the number of passengers carried by the railroads, especially for long-distance travel. Both the railroads and the builder of railway passenger cars can look forward confidently to the business which will come when we have finished our first, our major, and our terrible responsibility of quickly ending this war.

Discussion

K. F. Nystrom, mechanical assistant to chief operating officer, C. M. St. P. & P., said that Mr. Budd was entirely too modest in failing to cover more fully the great contribution which he and his organizaion have made to the theory and practice of passenger car construction. He expressed the hope that the Budd Company will do more pioneering work such as it has in developing the Budd disc-type brake to facilitate the satisfactory handling of modern lightweight passenger trains at high speeds. Mr. Nystrom said that the goal in weight saving in passenger car design should be to cut the weight of 160,000 lb. for present conventional cars nearly in half.

C. T. Ripley, chief engineer, Technical Board, Wrought Steel Wheel Industry, said that, from his own personal experience and observation, it is clear that individual railroads owe a great deal to Mr. Budd and his organization for the important part they have played in the development of lightweight passenger cars for railway service.

C. B. Peck, managing editor, *Railway Mechanical Engineer,* said that the one important respect in which railway passenger cars have a definite and unchallenged superiority over airplanes and highway busses is space, and that the real opportunity for the designer of railway equipment is to capitalize this advantage to the utmost in providing maximum comfort and freedom of movement.

Past and Postwar

Problems of Railway Research*

By W. I. Cantley†

Most people associate the word research entirely with those basic scientific investigations where inventive scholars discover new materials and processes such as are developed in the chemical and metallurgical fields; others think of pure invention where an entirely new machine or appliance is brought out. These things are, of course, the result of basic, or fundamental research and form the very foundation of technological progress, but the sphere of this type of research belongs to those industries that sell basic materials or finished products.

It has been our custom to purchase on the open market the thousands upon thousands of items necessary for the complete railroad system, relying upon the ingenuity of competitive business, guided by the demands of the individual needs of the railroads, to keep us abreast of new developments in materials and equipment. We have not done so badly in spite of the handicaps inherent in an industry of such great size and in which the first consideration of all is the safety of the passengers and cargo entrusted to our care.

This factor of safety always has been, and always will be, a brake on any efforts to bring about quick radical, or spectacular changes in railroad equipment, no matter how great the popular appeal of such changes may be. This does not mean new products, new materials, or progressive ideas are disregarded. In spite of what some people say, the railroads have always, individually and collectively, worked quietly and tirelessly to improve their equipment whenever it was possible to do so. They have always engaged in applied research, which is the type of research best suited to the needs and facilities of the railroad industry.

The Association of American Railroads is a clearing house of railroad problems and, as such, is often called upon to undertake a research project that may last for years. Such a project is exemplified in our passenger-car-axle investigation now in its sixth year. Although the most publicized result of this project was the adoption of a standard design axle having greater fatigue strength than the previous standard, many other phases of axle design and manufacture were studied, such as the influence of flame hardening, cold rolling, relief grooves, pulley fits, and so forth.

Out of the interest stimulated by our investigation an entirely new type of tubular axle was submitted for test, passed all requirements, and was adopted as an alternate standard. It must be recognized, however, that when the results of our efforts are distributed to member roads and interested organizations, the function of the association ends except for equipment subject to our Interchange Rules. The final authority as to the type of equipment that shall run on their own rails lies with the individual railroads. This is a baffling thing to some inventors who send in their models or sketches, thinking we can order them placed on all the railroads.

There is nothing spectacular in this type of research, which has been one of the reasons for much unfavorable criticism, but it is necessary and will always be a part of the gigantic effort called the railroad industry.

Progress has been somewhat retarded during the war period because of our inability to secure certain materials and, as a result, some phases of locomotive and car construction have remained static, but this is a temporary condition which we hope will soon be alleviated. In the meantime, planning and development are being carried forward and as soon as it becomes possible to do so, the use of higher grades of steel and various alloys will be greatly extended and entirely new applications of lighter weight and stronger materials will enter all fields of railroad construction.

Locomotives

Some of the more marked refinements permitting present locomotive performance have been the introduction of alloy steels into the valve motion and reciprocating parts; improvement in lubricants and lubrication; improved types of bearings for both locomotives and tenders, and the closer tolerances now practiced in locomotive construction.

A question frequently asked is "How much can we reduce the weight of locomotives and what would be gained?" Under good working conditions and with heavy traffic to be hauled, there is not much to be gained by a reduction in weight. However, where it is necessary to run locomotives on a weight-limit basis, where the capacity of bridges and road bed limit the weight of the engine, much can be done in reducing dead weight through the use of alloy steel in the boiler, rods, and so forth, as well as by using a better grade of steel in the construction of the beds with cylinders cast integral. The use of lighter-weight stronger metals, fusion welding instead of riveting in the boiler, and other refinements in accessories will permit stepped-up power to handle traffic in lightweight cars, both passenger and freight, at any desired speed.

There is room for improvement in the method of steam distribution. Much has been done on this, notably the experiments with poppet valves, but the most promising development in this field is what is known as the steam distributor. One type is now undergoing service tests and shows promise of considerable economy of power. Another promising type is in process of development.

Much has been accomplished in the way of fuel economy, but the situation with respect to coal and fuel oil after the war may be influenced by factors over which the consumers have no control. The enormous drain on our natural reserves of these materials is a matter of grave concern, and the longer the war lasts the more will our natural resources be depleted. This should be considered now to a point where an intensive study should be made to improve the drafting of locomotives, looking

* Abstract of a paper presented before the annual meeting of the American Society of Mechanical Engineers at a session sponsored by the Railroad Division held on Thursday, December 2.

† Mechanical engineer, Mechanical Division, Association of American Railroads. Mr. Cantley states that all opinions expressed in the paper are his own and do not represent the official position or policy of the Association.

toward the utmost economy of fuel for both new and existing locomotives.

One of the inherent difficulties of a steam locomotive is the dynamic augment set up by the reciprocating and revolving parts under certain conditions of operation, involving not only the engine itself, but the track as well. The results of the investigation carried on jointly by the combined Engineering and Mechanical Research Officers have not been completed, but we expect to be able to set up a formula for crossbalancing the various types of locomotives that will considerably increase their critical operating speeds. In addition, other useful information was obtained that may result in further improvements and economies in the operation of locomotives.

The modern locomotive tender requires such a large capacity for fuel and water in order to avoid stops, that it nearly approaches the actual weight of the locomotive itself. Undoubtedly, this weight could be reduced by the use of improved materials in the construction of trucks, side frames and bolsters, together with the use of tubular axles. The water bottom underframes, which are now of cast steel, could also be lightened up with a better grade of steel, or the use of welded construction, and the cistern proper could be all welded instead of riveted. It is doubtful, however, if any appreciable reduction should be made in the material of the cistern itself, as it is now the practice to use ¼-in. carbon-steel plates, and in some instances $\frac{5}{16}$-in., which is about as thin as any material should be to withstand the impact of surging water or fuel.

For a number of years the railroads have been replacing steam switching and yard locomotives with Diesel-electric units because of the flexibility and high percentage of availability of this latter type of power. Their use has also been extended to the hauling of lightweight, streamline name-trains, and a few heavy-duty units are now in service for the road hauling of heavy freight trains. The builders of this type of equipment have been steadily improving their product and will undoubtedly continue with refinements that will improve their service, but the ultimate progress of any equipment dependent upon high-grade fuel oil will depend upon the world supply of crude oil when this exhaustive war is ended.

The electric locomotive, deriving its power from overhead or third-rail systems, has been the source of much discussion and speculation over a number of years. In many respects it seems to be an ideal system of transportation, but the important question of economy is a large factor in considering its adoption. This type of engine seems best adapted to highly congested areas where power is available at rates that will permit operation within an economical range, such as the electrified portion of the Pennsylvania between New York and Washington. Here, again, the extended development of a useful and satisfactory type of equipment depends upon the availability of its source of power.

Many people have felt that a turbine engine would be the ultimate as a prime mover for the railroads, and experiments along this line have continued over the years. Mostly, they have developed along the lines of turbo-electric engines and, in fact, a locomotive of this type was built a few years ago. Evidently there are still some difficulties to be overcome as the experiment did not turn out satisfactorily.

There is now under way a comprehensive study of the potentialities of the gas-powered turbine for use in locomotives and, while it is too early to make any positive predictions, I am inclined to the belief that this type of power offers tremendous possibilities for an economical, simple and effective prime mover.

Freight Cars

The number of freight cars which will be permanentl retired upon cessation of hostilities will depend upon th immediate postwar requirements. A large number o cars, estimated at a million, should be permanently re tired in the next ten years, which is comparable to th 789,600 cars retired during the period from 1932 t 1940, inclusive.

We hear much about lightweight freight equipmen as a postwar development. Before becoming too enthus astic about the possibilities of light freight equipmen let us examine the problems confronting the designer of such equipment. The major problem confronting th designer of freight equipment is that of control of lon trains at high speeds. The difference between the empt and load-limit weight of a freight car is particularly un desirable for high-speed service as the braking force pro vided in the cars ranges from 60 to 75 per cent of th light weight of the car based on 50 lb. cylinder pressure

Considerable research work will be necessary befor an ideal lightweight car, capable of meeting all of th requirements of high-speed train operation is placed i service. To facilitate the work of the designer it woul be well to consider classifying lightweight freight equip ment into two groups: Group 1, cars to be used at mod erate train speeds to increase the ton-mile revenue an designed to carry bulk commodities; Group 2, cars t be used at high speed in long trains to carry expres freight.

The first group of lightweight cars should be designe to take advantage of the newer material and recentl developed methods of construction. The nominal loa limit of these cars should not exceed three times th light weight of the car unless some kind of special brak ing arrangement is developed to overcome the stoppin difficulties referred to above. Many of the problems foun in the development of such a car are similar to those in volved in the development of cars in Group 2.

The second group of lightweight cars should be de signed to meet the high-speed service requirement force upon the railroads by competition. These cars should b capable of being controlled in long trains with the sam dispatch as are passenger trains. The ratio between th light weight and load limit of these cars must be sub stantially reduced in order to obtain sufficient brakin power and truck-spring deflection for efficient high-spee service operation. A lightweight freight car suitable fo high-speed service should be provided with (1) truck with longer wheel base; (2) better spring suspension (3) suitable brakes; (4) effective and permanent longi tudinal cushion device.

The longer wheel base truck is advocated to reduc the frequencies of nosing and of the vertical displace ments. The vertical oscillations induced at the rai joints can be minimized if the rail joints were eliminate by welding. However, it will be years before all-welde rails can be expected. We also know that vertical oscil lations will not be totally eliminated as long as verticall acting springs are used. The difficulties experienced i providing suitable truck springs which will effectivel cushion the car body under every type of load are wel known. The difference in the weight of the car whe empty and fully loaded complicates the problem as muc as the limited travel allowed for the truck springs whic is governed by the permissible coupler height betwee light and loaded weight.

The introduction of truck snubbers has been for th purpose of dampening the vertical oscillations. Thi remedy is not a permanent solution to the problem a

ost snubbers are dependent on friction to absorb the pontaneous energy developed and this means wear. Moreover, most of the snubbers used operate only in ne direction. Their action prevents a quick compression f the truck springs, but they do not prevent quick re-ound. A study of the application and effectiveness of nubbers may disclose fatigue failures of side frames nd axles. A truck-bolster suspension which will permit nore lateral freedom seems desirable.

A long-range building program of new freight equip-nent calling for the construction of 125,000 new cars nd the retirement of a similar number of old cars yearly or eight years should be contemplated. Work on the lesigns of these cars should be begun now. The designs hould incorporate the use of welded construction and uitable high-strength steel with corrosion resisting prop-rties where found economical to do so. The use of ightweight materials, such as plywood, aluminum as uch, or in combination with other materials, should be ncouraged where comparable strength with lighter veight can be obtained. Strength sections made of folded hin materials have not yet been introduced in the freight-ar field. It is well to remember that the specific weights f respective lightweight materials are not indicative of he possible weight reductions and that the load-carrying erformance of railroad equipment is governed princi-ally by the deflection of the car structure.

The first designs agreed upon and tested should not e considered as final for the entire program, but should e revised and brought up to date from time to time, ased on experience, keeping in mind that the cars built nust be durable, free from maintenance, and capable of vithstanding shocks encountered in the higher switching peeds without damage to car bodies and lading. The ars, therefore, should be provided with a durable cush-oning device of constant capacity.

Passenger Cars

The development of postwar rail passenger transporta-ion will be governed largely by the demand. The Amer-can public is becoming air-minded and the loss of passen-ger traffic and revenue by the railroads must be studied with concern. Air lines are expecting to carry up to 70 per cent of the pre-war railroad trans-continental evenue passengers. The aircraft industries are now geared up to a high production of military planes. The arger type of military plane can easily be modified into uxurious air liners. However, air travel as an every-day, time-saving way of traveling must be considered n the light of the ratio of time of flight to time required o travel between business centers and airports. The otal cost of travel vs. the comforts enjoyed will, to many ravelers, become the influencing factors when choosing between air and rail transportation. A major portion of he traveling public will demand low-cost transportation t a reasonable speed, but a number of first-class travelers may resort to air transportation.

The use of lightweight equipment, which to date has nly been partially developed, can be furthered. The de-igners of lightweight cars have now available new ma-erials which can be incorporated into the structures of hese cars. To date, the weight of the standard coach car has been reduced from 172,000 lb. to 107,500 lb. Safety equirements imposed upon the railroads since these ightweight cars were built have caused the weight to e increased to 110,000 lb. per car. The weight of the omponent parts, in per cent of the total weight of these ightweight cars will range as shown in the table.

It is evident that only few reductions in the weight of the component parts of the cars can be made. Further

Distribution of the Weight of Lightweight Passenger Cars

Taken from the 1935 report of the Mechanical Advisory Committee of the Federal Coordinator of Transportation

	Per cent
Trucks	28 to 29
Underframe	15 to 16
Air-conditioning equipment	5 to 6
Side construction	5 to 6
End construction	1 to 2
Side and end sheathing	4 to 5
Roof construction and sheathing	4 to 5
Vestibule construction	2 to 3
Floor construction	3 to 3.5
Coupling equipment	4 to 5
Windows	1.5 to 2
Inside finish	2.5 to 3
Inside furnishing	4 to 5
Ventilation	0.25 to 0.3
Heating equipment	2 to 3
Brakes	1.5 to 2
Electric equipment	6 to 7
Insulation	1.5 to 2
Bolts and paint, etc.	2 to 2.20

reductions in the weight of specialties and finish are possible through research in the utilization of new light-weight material. The use of welded assemblies in lieu of castings offers a weight-reducing possibility. The air-conditioning equipment, the generators, and development of new insulation can be considered as possible items in which weight can be reduced. The inside finish should be kept simple and light weight.

The comfort or ease of riding of these cars at high speeds is dependent upon the track condition and the functioning of the trucks. Ample, but controlled, lateral motion should be provided in passenger trucks. Some device should be developed which will resist accelerations of the body, either vertically or laterally, in proportion to the forces exerted. Devices intended to dampen ac-celeration function proportionately with the displace-ment and not with the acceleration. A sudden stop of a lateral displacement at the end of the permissible travel of the car body is very annoying and adversely com-mented upon by passengers.

The outlook on the passenger service should be that air transportation will become a definite factor in long-distance travel. Much of the overnight rail sleeper traffic will not change. Travel between distances up to 400 miles in de luxe coaches, if as comfortable as it is safe, should appeal to the general public. Therefore, it behooves the railroads to revise their schedules for the benefit of the public and develop and plan the construction of postwar lightweight coaches which will enable them to meet com-petition.

The Place of a Central Research Laboratory

In outlining some of the more obvious needs and possi-bilities in postwar research, it seems to me there is a great future in store for a central research and testing laboratory, owned, operated and controlled by the rail-roads. Up to this time all our investigations have taken place in the laboratories of the railroads, universities or private industry, from all of whom we have received com-plete cooperation and satisfactory results. It should be recorded that in our associations with private research laboratories the companies involved have been completely above reproach in their relationship, enabling us to main-tain the integrity so necessary in any unbiased investi-gation. However, there are those who will always harbor some suspicion that influence might have been exerted. For this reason, if for no other, a railroad-owned testing plant would have a beneficial effect on all associated in-dustries. Furthermore, it would tend to avoid duplica-tion of effort where several organizations may be working on the same problem, each without knowledge of the other's activity. Such a laboratory should include a loco-

(*Continued on page 14*)

Postwar Possibilities of

Materials for Railroad Use*

By C. B. Bryant†

Under normal peacetime conditions, railroads consume about one-fifth of the total production of steel in the United States. This represents a tremendous expense and, if there is any means by which that expense may be reduced and the life of our steel products increased, we must adopt it. It has been estimated that about one million tons per year of steel are lost by corrosive action, a large part of this loss occurring on railroads. As we look ahead into the post-war period, we are seeking for means of reducing that loss. Some of the new metals, particularly aluminum, may be an answer to part of that problem. Under most conditions aluminum is non-corrosive and should have long life from the standpoint of corrosion. We are making studies at the present time of the possibilities of aluminum in freight cars.

Steel itself may be rendered relatively non-corrosive by various alloy additions. These do not entirely prevent rusting but they materially retard it and low alloy steels having a corrosion life several times that of ordinary carbon steel are now available. They have been recognized to a considerable extent in freight car construction but are still not generally used. Such uses will probably increase. Stainless steel has already been recognized in a major way in the construction of passenger cars. Due to the high cost of stainless steel resulting from its high alloy content, it would appear that passenger equipment is as far as we shall be able to go in the use of stainless steel.

Regardless of what we may do in substituting non-corroding or slowly corroding steel, unquestionably our major use of steel products will in the future continue to be the ordinary carbon steel variety which requires some form of protective coating. This means paints. The paint industry is changing rapidly with respect to the types of materials used. The plastics industry has developed a large variety of synthetic resins which, when incorporated into paints, improve the durability and protective action in a major way. Many of the synthetic resins we know about we are not able to use today because of military priorities. It seems certain that after the war these resins will be largely used in the protection of railroad equipment and structures. Similarly, rust inhibitive pigments are being improved and new developments are taking place.

While the losses of material due to corrosion and decay are serious, they are slight in comparison with the actual wear and tear of material in railroad service. In wheels we suffer great losses due to abrasive wear of metal from the treads. Methods of heat treating the steel in wheels have been developed and greatly extend their life. Such heat-treated wheels are used on most of the high speed passenger trains and on certain locomotive wheels.

On a conventional railroad axle, the journals on which the bearings are carried, gradually wear away until a condemning dimension is reached, at which time the axles must be scrapped. We can extend the life of such axles many times by use of anti-friction bearings which avoid abrasive wear on the journals.

Metal spraying can be used to apply hard steel coatings on parts which have worn in service. These parts can then be remachined to their original size and returned to service. Metal spraying is already used to a considerable extent in the automotive industry in building up worn crankshafts, etc., and is being used to a minor extent in railroad operations in building up piston rods and similar parts. As the method becomes improved, it will doubtless have much wider application in railroad service in building up other parts when worn, thus enabling their continuance in service.

One of the wartime developments in preventing wear is the electro-plating with hard metals, particularly chromium, of wearing surfaces. This method is being used almost entirely in military applications and is not available to us today. Internal combustion engines electroplated with chromium on the inside of the cylinders and on the outside of the pistons have greatly lengthened service life.

There are many parts of railroad equipment where wear takes place in which flame hardening, which is a type of localized heat treatment, can be applied in order to reduce wear. In locomotive crossheads, the flame hardening of some of the steel surfaces will prolong the intervals between renewals. In our manufacture of frogs we are experimenting with the flame hardening of certain areas of the rail comprising the frogs so as to reduce the wear at those points where the abrasion and impact of wheels is most severe. The process looks very promising and will be extended.

Possibilities for Saving Weight

The great weight of railroad rolling stock focuses attention on any method of reducing weight so as to make possible hauling more pay load without increasing total weight of equipment plus load. Aluminum, already mentioned as having advantages in resisting corrosion, also has advantages in reduction of weight. A number of experimental aluminum freight cars have been built and others are projected. The decision on uses of this sort is strictly an economic one and we must balance the reduction in weight and the resulting lowering of operating expense against the increased cost of equipment built with aluminum. It is too soon to state just where and how extensively aluminum will be used in freight car construction. Unquestionably it will find large applications. Magnesium is still too new for us to hazard any guesses as to whether it will be available and attractive in railroad equipment.

Even in all-steel car construction, it is possible to make substantial reductions in weight by taking advantage of the high strength of the low alloy steels. In an ordinary 50-ton freight car it has been calculated that we can save approximately three tons by the use of low alloy steel instead of ordinary carbon steel. For these three tons

* Abstract of a paper presented at the annual meeting of the American Society of Mechanical Engineers (Railroad Division).
† Assistant to the vice president (research and test), Southern.

weight saving we must invest under present conditions an additional $126.00 per car. Assuming an extremely conservative figure of operating saving, it appears that the additional expense of the high strength low alloy steel should be recovered in a period of approximately five years and that for the remaining service life of the car, probably another 20 years, the weight saving would accrue as an operating economy. Unquestionably there will be many more cars built of steels of this type in the future.

We need rolling stock of better overall performance than we now have. The high speed tank car trains transporting petroleum to the east coast have shown considerable weakness in our conventional trucks and other parts which perform satisfactory at low speeds but which must be improved in order to permit continued high speed operation. Our spring action is imperfect at high speeds. In tank car operations this situation is being met at least for the time being by an extensive program of equipping tank cars with snubbers to restrict the harmonic bouncing of the springs.

The use of anti-friction bearings in locomotives and cars will improve their performance greatly, and, as you know, such bearings are virtually standard equipment on all new passenger cars and most new locomotives. The economies of anti-friction bearing applications in freight equipment are not fully determined as yet. The manufacturers of anti-friction bearings believe that there is an economic advantage in their use in freight service but as yet railroads have not been convinced. The fact that this subject is debatable and that it is being discussed, implies that there is a good possibility of an economic use of anti-friction bearings in freight equipment and the post-war period will doubtless see a considerable number of freight cars so equipped.

We suffer a certain amount of damage to commodities being handled in box cars due to condensation of moisture on the inner surface of box car roofs which drips down and damages the lading. Some form of insulating material which could be applied cheaply which would prevent this sweating and dripping, would avoid such damage. We need non-porous linings for the floors and on the sides of box cars. We frequently have damage claims due to oil or other deleterious materials soaking into the conventional wood floors or sheathing and later feeding back into easily damaged commodities, such as cigarettes, sugar, flour, etc. A non-porous lining material which would not soak up such materials would be of great advantage.

Wartime Products Open New Fields of Use

There is a large group of new materials which we are watching because they will be available in volume after the war, the uses for which we do not now appreciate. Aluminum, for example, is now available at an annual rate of about two billion pounds, which is more than ten times the maximum rate of pre-war production of aluminum. All of this is now going into military uses. When, after the war, these uses no longer exist, this tremendous capacity will be available for ordinary industrial purposes and doubtless many applications we do not even think of today will be found.

In the field of steel, the war has forced on us, because we do not have enough alloys to use in the conventional way, a new series of steel chemistries. These have been developed under the name of the National Emergency Series of Steels. The basic theme of the NE steels is the use of smaller quantities of alloy than have been conventional and it has been found under the impetus of wartime demands that such steels with low alloy content can by proper methods of heat treatment be used effectively where high alloy steels were formerly thought necessary. Since alloys are much the most expensive elements in steel, the NE steels will offer us a means of using alloy steels in more places than have been economically possible in the past.

In the new field of plastics, now so rapidly developing, there will doubtless be a great many applications in railroad service. We have already used plastics in the interior trim of passenger cars but so far have made no appreciable applications for purely utilitarian purposes. One such possible application which we are discussing is in providing better seals for the journal boxes on our freight equipment. A plastic self-conforming journal box lid coupled with an effective dust guard would greatly improve bearing performance.

The plastics industry has been trying for some time to produce a synthetic bristle suitable for paint brush manufacture. One such synthetic bristle is being marketed in considerable volume. Unfortunately for us, synthetic bristles are restricted to military uses at present. It is my understanding that they are entirely successful as a substitute for the natural bristle and we shall be independent of the importation of natural bristle for paint brush manufacture in the near future.

The Association of American Railroads is at present working on specifications for air brake hose which will avoid the use of natural rubber and in the near future you will be riding on trains in which the brakes will be controlled by air carried through synthetic rubber hose. The War Production Board has just issued instructions requiring rubber hose manufacturers to adopt synthetic materials in such hose in order to release our remaining supplies of natural rubber for uses where substitutes have not yet been worked out.

The subject of locomotive design is an extremely active one at present and important changes are in prospect. In our Diesel locomotives improvements in Diesel engines, probably the use of smaller cylinders and more cylinders per engine, seem likely. The present costly and heavy electric transmission may be supplanted in part by some direct mechanical drive, probably through fluid couplings.

Commercial installations of gas turbines are already operating successfully and on one locomotive in Switzerland a gas turbine is now in use. Because of wartime restrictions, we are unable to learn much about this Swiss installation. American manufacturers of gas turbines have designed locomotives and are waiting only for the release of materials in order to construct some for use in this country.

Because of fuel considerations, it seems certain that the steam locomotive burning coal will continue to be the chief motive power used on American railroads. In this type of locomotive also development is proceeding rapidly. Boiler pressures of 500 lb. per square inch are in prospect and this will improve locomotive performance as well as economy. A direct drive turbo locomotive is under construction. This design would have great advantage over the reciprocating type in avoiding counterbalance difficulties and in permitting higher speeds without destructive effect on track and structures. A multi-cylinder steam locomotive is on the drafting boards. This proposes to use a large number of small cylinders directly connected to driving axles. No counterbalancing difficulties would exist.

There are several new processes available which will doubtless have railroad applications. In the rapidly expanding field of electronics, now so much advertised,

there are valuable methods of process control, particularly heat treating, which will be of help to us. The induction heating of metals for processing and for heat treating will enable us to control quality of critical parts better than at present.

The use of infra-red heat for the drying of paint is already common in the air-craft and munition industries. The use of infra-red drying enables paint to be applied and re-coated within a period of a few minutes. When we build freight cars under present conditions, it is necessary for the car builder to have a very large paint shed together with expensive track storage facilities in order to take care of the three coats of paint which are conventionally used. If all three coats could be applied with assistance of infra-red for drying without moving the car and all within the space of a few minutes that element of cost would be materially reduced.

The post-war period will make available to us better methods of inspecting materials, such as by use of X-ray and by the use of radium emanation. Military uses are requiring all possible output of equipment of this type under present conditions. One railroad has employed the radiographic testing of welding, which was applied to a long stretch of welded track installed in a tunnel.

As you can see from the high points which have been mentioned, railroads have a tremendous field of new materials and processes to consider and to choose from in shaping post-war activities.

Discussion

W. M. Sheehan, assistant vice-president, General Steel Castings Corporation, referred to the advantages of flame and induction hardening which produce exceptionally hard wearing surfaces without sacrifice of strength and ductility in steel castings, now being made with yield points up to 100,000 lb. per sq. in and with tensile strengths proportionately higher. Mr. Sheehan referred to the effective work of various A.S.M.E. professional divisions including the Railroad, Metals Engineering, Fuels, Oil and Gas Power, Rubber and Plastics and urged railroad men to take full advantage of all the information which these various A.S.M.E. divisions have to offer, bearing on railroad work.

Problems of Railway Research

(*Continued from page 11*)

motive testing plant and experimental track, together with facilities for the testing of axles, draft gears, journal bearings, brakes, and all the other apparatus now scattered over the country. Because of the close cooperation between the research offices of the Engineering and Mechanical Divisions of the Association, such a laboratory would house the staffs and equipment of both offices, thus bringing even closer the ideal of interrelated research between track and equipment which are dependent upon each other.

Discussion

Lawford H. Fry complimented the author on the paper but objected to the suggestion that reducing the dead weight of a locomotive does not result in much gain. Mr. Fry said that if the reduction in weight can be used to give increased boiler capacity it is well worth while.

C. T. Ripley spoke in favor of a central research organization and laboratory which he believes has tremendo possibilities for improvement in railway service and op ation. He said that the making of duplicate tests on i dividual railroads and the failure to exchange informati regarding test results in highly expensive and inefficie

A. I. Lipetz, chief consulting engineer, American Lo motive Company, said that the railroads should no consider whether tractive effort or efficiency are mo important, as the locomotive is not only a machine r quired to develop high initial tractive effort in starti but also capable of sustaining enough drawbar pull haul heavy trains at high speeds.

R. M. Ostermann, vice-president, The Superheat Company, said that future development of the steam loc motive depends upon thermal grounds and designe must do their utmost to secure an increased heat dro which means larger steam expansion.

W. S. H. Hamilton, equipment electrical enginee N. Y. C., said that the electric locomotive is the only typ of motive power with either tractive effort or hors power limited only by the locomotive weight and powe available at the powerhouse. He said that manufac turers must reduce the cost of electric locomotives an power companies supply cheaper power. He maintaine that the rapid acceleration features, characteristic o electric locomotives, are not fully appreciated and, whe they are, much wider use of it may be expected.

Col. N. D. Ballentine, assistant to trustee, N. Y. O & W., spoke in favor of a central research organizatio which should develop information regarding many fac tors now being overlooked.

A. F. Stuebing, development engineer, Carnegie Illi nois Steel Corporation, said that over 50,000 lightweigh freight cars, embodying all different types of construc tion, have been in service, some as long as 9 years, on 50 railroads and private car lines and that the railroad and car builders should study experience with this equipment as a basis for new designs. He maintained tha high strength cars with thin sections are standing up i service, but further efforts should be made to determine the minimum thickness of a section which is most generally satisfactory and economical. Mr. Stuebing referred to the effect of lightweight freight cars in reducing motive power requirements and stressed this advantage in reducing the cost of operating high-speed trains.

K. F. Nystrom said that increased speed is the key-note of the transportation problem and that, under favorable conditions it is entirely feasible for railroads to operate safely on tangent level track with passenger trains up to 150 miles an hour and freight trains up to 100 miles an hour. He said that passenger car design should be functional and not merely consist of adhering to precedent and "keeping up with the Joneses." The application of skirts to passenger car sides, for example, may improve cars from an appearance standpoint, but are a detriment mechanically since they raise the sound level in the cars 2 points and assist in the accumulation of as much as five tons of ice under the car body during winter operation in northern climates. Mr. Nystrom said that no freight car trucks are in service today which entirely meet the requirements and that length of wheel base is not fundamental in determining the riding qualities of a truck. He maintained that more important factors are properly located springs, more spring deflection, ample provision for lateral play and a good deal of rubber to reduce noise. Mr. Nystrom stated that present car axles are too heavy and the hollow axle development seems to hold considerable promise. He said that roller bearings are essential for high speed operation of freight cars as well as passenger cars.

The Education of Engineers*

By Roy V. Wright†

Postwar problems on railroads will call for men thoroughly grounded in fundamentals—Cultural training in lieu of specialization needed as a foundation for broad leadership—Instruction in duties of citizenship recommended

In 1931 it was my pleasure to meet groups of engineers of all kinds at engineering meetings in a number of communities widely scattered throughout this country. Several times this question was asked: "How many engineers in the room are today practicing that type of engineering on which they specialized in college?" In some instances more than 50 per cent were not so doing. Men who, for instance, had specialized in civil engineering at college, were practicing mechanical engineering, electrical engineering or mining engineering, and vice-versa.

That same year, as we were getting deeper into the depression, a young engineer, possibly seven or eight years out of college, came to see me for advice about securing a position. He was a graduate mechanical engineer and after leaving college had gone into a highly specialized field. It was one of the first to be hit by the depression and there seemed little possibility of its reviving as long as business remained subnormal. I made a number of suggestions about possibilities in other lines of mechanical engineering. He showed little interest in these, because he insisted his experience had been entirely in the highly specialized field and he did not feel that he could adapt himself to another phase of engineering—this in spite of the fact he was a graduate engineer of one of our oldest and best known engineering colleges.

There was a time, many years ago, when economic and industrial progress was slow; a man might go through an entire lifetime without suffering any severe upsets because of radical changes in his profession or occupation. Those days have passed. Today we cannot afford to allow ourselves to get into a rut, but must be ever on the alert to adapt ourselves to radical changes in conditions in business and industry, or in professional work.

Know Fundamentals and English

This emphasizes the fact that it is of prime importance in engineering education to give the student a thorough grounding in fundamentals, so that when he completes his college course he will be prepared to adapt himself to almost any type of engineering work. He may want to take specialized post-graduate work in college, particularly if he is research-minded, or is specially well equipped to advance along certain highly scientific lines. In most instances, however, the young man with a good, sound basic training in the fundamentals of engineering will find that there will be ample opportunity to continue his training and preparation on the job, as he finds his place in engineering or industry.

Many engineers will tell you of the difficulties that they had in adjusting themselves to their life work, because for one reason or another they were not so trained in college as to have a thorough understanding of how to apply mathematics and engineering principles. Possibly this is because "the book" is followed too closely and not sufficient effort is made to train the engineering student on how to think and how to utilize his imagination. That is a big task and the student will do well, if possible, to go to an engineering college where the members of the faculty have some reputation for achieving this end.

Most engineering colleges have in more recent years taken active steps to correct one of the weaknesses in engineering education. That is to see that the engineer is better trained in the use of English. It is a tool which is invaluable if he expects to make much real progress. An engineer must know how to express himself accurately and forcefully on his feet, if he is to convince his superiors of the value and importance of the things he is developing. Moreover, he must be able to put his thoughts clearly and logically in writing, for he will be called upon to make numerous reports, or to carry on extensive technical correspondence, or write complicated specifications. It will be a great day in the progress of engineering education when every professor will be as careful to train the student in making a clear-cut and effective presentation on his feet or in writing, as he is in being sure that he has a good understanding of the technical subject being taught.

Leadership and Social Consciousness

The engineer, as well as other college and university trained men and women, will not be able to make his best contribution or to give the best account of his talents, unless he is trained to regard himself as a responsible member of the community. The time was when the engineering students in many of our universities kept pretty much by themselves and took pride in the fact that they were the overall boys or the roughnecks of the institution. That day has passed and in some of our universities the members of the engineering school are leaders in university affairs.

It is becoming more and more generally recognized that the engineer must develop a social consciousness. In at least one engineering college, the Carnegie Institute of Technology, what is known as a Social Relations Program is followed throughout the entire four years of the college course. More and more our engi-

* Abstract of a paper presented before the annual meeting of the American Society of Mechanical Engineers at a session sponsored by the Railroad Division held at New York on Thursday, December 2.

† Vice-president, Simmons-Boardman Publishing Corporation.

neering colleges have come to the conclusion that time must be taken, even though certain technical subjects may have to be subordinated or eliminated, to train the students along these broader lines. While it is true that at best not much time can be devoted to them, a tremendous amount of progress can be made by careful planning and proper emphasis.

There is a tendency in some places to go a step further, and because the citizens of this Republic are the rulers and should know how to make their influence felt in civic affairs and government, to give them some training or coaching in this respect. Our own Society has an Engineers' Civic Responsibilities Committee. While it has made slow progress, it is now devising more or less ambitious plans to stimulate thinking along these lines in our College Branches and to secure the co-operation of the Local Sections in so doing.

Certainly in a public utility, such as the railroads, which requires a strong public and employees relations program, it would be a real asset to have the men in the technical departments understand the importance of good and responsible citizenship and be prepared to do their part in assisting the communities in which they live to understand how to deal best with the public utilities and industries which serve them.

A Place for Cultural Training

Have you not often been amazed at some of the ugly machines that have been designed, or at some of the crude looking concrete structures that have been erected? It has been suggested that the most efficient and most effective machines are those which are most artistically designed. The first models are almost always crude and awkward, but as the design is refined through experimentation and refinements in engineering design, the parts take on more graceful lines. The Metropolitan Museum of Art has an industrial art department, widely used by industrial designers and manufacturers.

The value of art appreciation on the part of the railway mechanical engineer is reflected in the keen interest the public has taken in these recent years in the streamlined and modernized passenger trains. We all realize how much they have done to improve the competitive position of the railroads in attracting passenger business. It is of interest, also, in this connection, to note what is being done throughout the country in the modernization of railroad stations and the extent to which the engineer has taken advantage of more artistic arrangements and interior finishes.

We have accomplished so much in speeding up engineering training for the young men entering the services that a goodly number of people (some of them prominent educators) have suggested that it is all nonsense to spend four years in college, and that hereafter engineering courses should be completed in a much shorter time. But at what expense has this been done?

The non-technical and cultural studies which help the engineer better to implement his technical training and make him a more influential factor in the community have been brushed aside. He is being trained as a technician, rather than as a responsible citizen—a sort of robot, rather than a well balanced individual. That may be necessary under war emergency conditions, but it bodes ill for the future, when we return to more normal times, unless the men now being so trained deliberately take steps to overcome the handicap.

Certainly the railroad mechanical engineer of the future, if he is to give the best account of himself and help the railroads improve their services in such a way that they can meet the competition of other types of carriers, will have to understand far more than how to operate a slide rule or apply mathematics and engine ing principles on a cold-blooded basis.

Duties of Citizenship Need Stress

One other thing—we have been thinking in terms the railway mechanical engineer. Few mechanical en neering graduates, however, who go into railroad wo will achieve that particular position, even though th may have had that goal in mind as students. As th climb upward from the bottom of the ladder they w find themselves distributed throughout the mechanic department in all sorts of special or supervisory capa ties, depending upon their peculiar abilities or oppo tunities. As they adapt themselves to these new pos tions it is quite likely they will find that their high technical knowledge will be used less and less, and th they must study to develop their managerial and admi istrative abilities. Here is where the non-technical a broader phases of their college training will demo strate their value and importance still more forceful

Many, many men trained as mechanical engineer who started in the railway mechanical department, ha eventually found their life work in other departments-operating, stores, purchasing, traffic, executive, etc.— with railway supply manufacturers in a variety of c pacities, including sales engineering and promotion publicity, or in engineering education or the publicati field. Here, again, the broader training to which I ha referred is invaluable. We have made the mistake over-technicalizing our engineering training in the b lief that we could not spare the time for English, indu trial history and economics, which were classed more less as cultural studies in spite of their practical val in fitting the engineer to implement his technical know edge. Art appreciation, even when directed along eng neering and industrial lines, or the study of social rel tions problems, have had scant consideration.

And the most important factor in a Republic, that making the engineering student "citizenship conscious, is woefully neglected. Engineers claim they are to busy to be concerned with political and government activities, although more and more in these later day they are being jolted out of their coma into partial con sciousness. Newark College of Engineering has had discussion course on responsible citizenship for about decade and it has demonstrated its value, in spite of the small amount of time allotted to it. Let us hope that our educators in all fields will awaken before it is too late, and we have sold our birthright in a free land for a mess of pottage.

Discussion

Dean A. A. Potter, Purdue University, complimented Mr. Wright on his paper and said that it expresses the best thoughts of the leaders of engineering colleges throughout the country. He said that, in the field of engineering education, emphasis should be placed not on specialization but on those courses which will give students a good fundamental background in engineering and particularly in correct methods of thinking, as well as forceful expression, both verbally and in writing, and in acquiring a new appreciation of the important part which engineers must play in promoting human progress.

Dean S. W. Dudley, Yale University, also emphasized the importance of sticking to fundamentals in engineering education without too much emphasis on specialized courses which restrict the viewpoint and tend to limit the usefulness of technical graduates who often, and in fact usually, find employment in fields widely different from the ones they expected to enter.

EDITORIALS

System-Wide Planning Needed

Present conditions make it impossible in most instances to do very much in the way of altering, re-equipping, rebuilding or relocating shop facilities on the railroads. They do offer, however, the best of opportunities for studying mechanical-department shop needs because of the peak demand now existing for available motive power and rolling equipment. Certainly the shortcomings of existing installations are being made painfully clear to every mechanical supervisory officer whose duty it is to have locomotives and cars ready as and where needed for passenger and freight movements.

Planning for the future should include a detailed study of the existing set-up with a view toward eliminating the bottlenecks and sore spots now being uncovered. And this is the time when it should be initiated. We are all familiar with the attitude of a very sick patient who resolves never again to take chances which can lead to a recurrence of illness. This state of mind begins to fade during convalescence and usually disappears completely after full recovery. A similar fading of interest in effective changes can be expected to occur as demands on existing railroad mechanical facilities decrease to a point where they are again adequate in capacity, even though inconvenient and unduly expensive to operate.

For years past most roads have undertaken many measures aimed at improving the mechanical performance of their equipment and speeding and improving their shop output. But, most of the measures to which we can look were directed only at specific applications or problems and were not parts of a general program to raise the level of performance throughout the entire mechanical department. Many of them were forced because a particular set of conditions had become so bad that something had to be done.

It is safe to say that there is no locomotive or car shop, no engine terminal or rip track, no matter how modern, which cannot be improved. The changes needed may fall in one or many categories: purchase and installation of new machine tools and shop equipment, improvements in shop scheduling, rearrangement of existing facilities, erection of new shop structures, abandonment and consolidation of repair shops and tracks are only a few. None of these, separately, are new problems but they all need to be studied together now so that planning can proceed on a division or system basis rather than on the basis of relieving pressure on or improving individual installations.

Such planning will need to take into consideration the changes in traffic volume to be expected in the coming days of peace but, making allowances for war-produced conditions, the present critical stage of maximum demand on repair and maintenance facilities should be made the starting point. The mechanical department is more properly to be regarded as a unit than as a number of scattered shops and repair points.

Manpower Problem Calls for Action

There are many evidences that the need for understanding of the problems of the railroads relating to manpower is the number one requirement of the moment, for if the roads do not find some practical solution, those who rely on the railroads, including the armed services and the defense industries may well prepare themselves to accept a standard of service that will be considerably less efficient than that to which we have become accustomed in the past 24 months. Since August the unfilled personnel needs of the mechanical department, as reported by the United States Retirement Board, have been climbing. The increase in September was quite sharp, less so in October and only slight in November. The overall change was from 22,000 in August to 29,400 on November 1.

The shortages are greatest in the labor groups, helpers, machinists and car men. The shortage of miscellaneous laborers has been high throughout the summer. They mounted to 4,305 on November 1. The shortages, as of that date, of shop laborers, stores laborers and helpers were 4,057, 1,700 and 3,218, respectively. The shortage of machinists increased from about 2,200 during the summer to 2,715 and the shortage of car men from 2,000 in September to 2,259 on November 1.

Railroad managements find themselves in an uncomfortable position as regards personnel, for the difficulties occasioned by the loss of men to the armed services, through recruitment of railway battalions, enlistment, selective service and the labor turnover have now been amplified by temporary losses because of absenteeism due to sickness and other causes. It may not be out of order, to emphasize a point, to call attention to what seem to be the end results of rather short-sighted past practices on the part of some railroads as compared with other industries.

At the outbreak of war, in an honest endeavor to do the job which was most important, railroad management accepted the position of a civilian industry rather than a defense industry. Pride of accomplishment in many cases caused railroad men to consider too lightly situations which were acute enough to have been faced squarely and dealt with in a cold, practical manner. We cannot help but feel that if many railroad officers had pointed out to those concerned, outside the indus-

try, what end results might be looked for when reserve capacity was used up, there might have been an entirely different attitude toward one or both of the questions of equipment and supplies and manpower. When labor personnel, both skilled and unskilled, is insufficient, adequate supplies of materials and equipment will avail little in stepping up the production of passenger-miles and ton-miles.

Our own contact with railroad mechanical officers and supervisors in the past 30 days has been a prolific source of information relating to the difficulties that are facing the roads. Labor turnover, sickness and the continued drafting of railway personnel for the armed services has brought about a situation where immediate action is necessary. Strangely enough, the most desperate need is for the retention of that type of labor that is most difficult to prove essential, namely laborers and helpers. Around any shop, either car or locomotives, and at any engine terminal there is a vast amount of plain, ordinary hard-labor jobs to be performed. The cleaning of fires and coal and water servicing at enginehouses are cases in point. These jobs have to be done or locomotives do not move and if there are no unskilled laborers to do them then the skilled men, or even the supervisors, have to pitch in and get things moving. In a certain mid-western despatcher's territory, in mid-December, there were 1,700 loaded cars waiting for power to move the trains and the power was at the enginehouse waiting to be serviced—while 12 per cent of an already depleted labor force was off because of sickness.

The detailed discussion of the present needs of the roads could be carried on and on. That would serve no good purpose. What is needed most is immediate action to stop any further drain on manpower. It may be that the present close contact of the armed services with railroad operation will help gain a hearing for the roads on a situation that can have a very direct bearing on the prosecution of the war.

Designs Adapted To Future Needs

An improved situation with respect to the production of railroad equipment is foreseen for 1944 by Joseph B. Eastman, director of the Office of Defense Transportation. This may, he says, permit the acquisition of some new passenger cars before the end of the year. For some time the railroads have been obliged to accept cars and other equipment which have not been 100 per cent of the best type, but recently they have begun to see the end of the war when they will have to resume normal competitive operations. This has caused them to look more critically at the equipment being offered.

The situation is one which applies with particular force to passenger cars. In the post-war period, competition will be most keen in the passenger field. To meet it the railroads must equip themselves with the best their ingenuity and that of the builders can offer. Among the future requirements will be designs which take every advantage of the space which is available in a railroad car and not in a bus or airplane. Room-type will displace section-type sleepers. Designs are already available which use space to advantage. There will probably be a continued demand for overnight coaches and these will require more comfortable seats and upholstery and interior finishes which are both beautiful and durable.

Other things anticipated are modulated air conditioning which avoids sudden changes of humidity, simplified and perhaps standardized methods of air-conditioning control, more effective air filters, improved lighting—both incandescent and fluorescent—and adequate power supply systems. Dining cars will probably be equipped for mechanical refrigeration of food. Higher train speeds, necessitating modulated brake control, anti-wheel-slip control, and in some cases dynamic braking, are projected.

If cars are built now, it is probably that only a few of these refinements can be included, but if they are given consideration, car designs can be controlled to permit their addition when they become available.

Enginehouse Betterments Demonstrate Their Worth

Nowhere has the value of improved engine terminal facilities been better demonstrated in their effect in promoting increased locomotive availability than on the Norfolk & Western, at Roanoke, Va., where extensive improvements and expansion of the yards and engine terminal were started in the fall of 1940 and completed last summer. As pointed out by C. E. Pond, assistant to the superintendent of motive power, in a paper presented at the annual meeting of the American Society of Mechanical Engineers in New York on December 1, this engine terminal, built in 1918, consisted of a single 40-stall enginehouse and outside facilities planned for servicing a maximum of 80 locomotives a day. The improvements mentiond have increased the handling capacity to 135 locomotives in 24 hrs.

Without going into the details of these improvements which will be covered in a subsequent issue of *Railway Mechanical Engineer,* suffice to say that a time study of various locomotive servicing operations, conducted with the use of the new facilities, shows the following average time in minutes:

Ash pit	22
Inspection pit	17
Coaling station (including taking sand)	8
Washing platform (including blowing down and taking water)	18
Engine inspection sheds	22
Total	87

A further analysis of operations at the improved engine terminal shows 35 per cent of the locomotives switched back without being turned, 28 per cent of the

locomotives turned on the turn-table but not placed in the enginehouse, making a total of 63 per cent of the locomotives serviced, which do not go into the enginehouse. The total elapsed time between arrival of a locomotive at the ash pit and the time it is actually ready for service, taking an average day for all classes of locomotives, is 3 hrs. 52 min.

A point of importance in considering this figure is the fact that the majority of locomotives serviced at this terminal are heavy, articulated types some of which develop a tractive force of 152,206 lb.

Prospects for More Locomotives and Cars

After two years of broken records of utilization of locomotives and freight cars, which led many persons within and without the railroad industry to wonder when, if ever, the limit of capacity of American railroads would be reached, definite and positive evidence that the limit had been reached was presented in 1943. There were freight-car shortages during the spring and from mid-summer on—the first extensive shortages to be recorded since 1937. While not as tangible statistically, there was also evidence that little more could be gotten out of the available supply of motive power than was gotten in 1943.

Will additional equipment be needed this year? What are the prospects for the procurement of additional locomotives and cars during 1944?

It seems evident that the nation approached close to its productive capacity during 1943. The prospective increase in freight traffic, measured in net ton-miles, has been estimated from about two to five per cent. There will probably be little if any increase in tonnage; the larger volume will be the result of a continuance of the increase in the average haul which has been taking place steadily during the past two years.

Last year opened with allocations for 20,000 open-top cars authorized for the first six months and 12,000 open-top cars authorized during 1942 but not delivered until after the heavy fall movement. The increase in cars owned by the Class I railroads from October 1, 1942, to October 1, 1943, was less than 17,000; total cars of all types on line had increased about 28,000. It seems probable that the available capacity for freight-car building will limit the railways to a maximum, not exceeding 50,000 new cars during 1944. How many of this maximum are actually built will depend on how far military and lend-lease requirements are allowed to encroach upon the time of these facilities during the early months of the year.

The locomotive situation is even more acute than the freight car situation. While it has not reached a serious stage ground is steadily being lost in locomotive conditions; locomotives are coming into the shops needing more work and more renewals with each successive shopping. The present prospects are that something over a thousand new locomotives will be made available to the railroads during 1944, of which about 600 will be Diesel-electric and 500 steam. Whether this proves an adequate supply depends somewhat on the trend of the manpower situation. Should it become further strained, new power will be required to replace slowed up repairs.

New Books

Studies in Arc Welding. *Published by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. 1295 pages, 6 in. by 9 in., illustrated. Price $1.50 in the United States, $2.00 elsewhere.*

A collection of prize-winning papers on arc welding submitted in the Foundation's 1940-42 Industrial Progress Award Program. There are 98 papers on various welding subjects which represent the work of 113 authors or co-authors. Most of the papers are published in their complete form; a few are comprehensive briefs of very lengthy contributions. There are nine sections with 98 chapters. Each chapter deals with a specific design subject, each section is devoted to a particular field of application. The railroad section has nine chapters covering 108 pages with 87 illustrations. The subject matter includes arc-welded Diesel-electric freight locomotive; arc-welded construction of a fireless locomotive; welding a locomotive boiler; welded design of a 250-ton flat car; arc-welded conversion of tenders into tank cars; underframes for all-welded railroad passenger cars; arc-welded suspension for air-conditioning systems; construction of a rail-grinding car; fabrication of a steam locomotive cylinder.

Diesel Locomotives—Mechanical Equipment. *By John Draney. Published by the American Technical Society, Chicago. 472 pages, 5¼ in. by 8 in. Price, $4.00, cloth bound.*

This is the first book to be published in the United States in which the pertinent information relating to the mechanical equipment of Diesel locomotives has been assembled. The opening chapters in the volume deal with the elementary principles of various types of Diesel engines and explain in detail the design and functioning of such important parts as the fuel injection pumps, nozzles, governors and the lubricating and cooling systems. Another group of chapters is devoted to the construction and maintenance operations required on each of the makes of Diesel engines that are in use in locomotives in this country. A section covers the specifications and operating instructions for the principal makes and sizes of Diesel locomotives, while still other chapters describe the facilities required at shops and engine terminals for the servicing and repair of this type of motive power. The final chapters of the book deal in considerable detail with trucks, auxiliary equipment and the steam generating units installed for heating service. There is a companion book on the electrical equipment of Diesel locomotives, by the same author. This will be reviewed in a later issue.

Coupler and Draft-Ge

Accelerate A. A. R. Draft Gear Program

The excellent freight train operating efficiency of the critical year of 1943 was due in no small measure to the accelerating effectiveness of the draft gear maintenance program provided for by the Association of American Railroads' Rules of Interchange. These rules classify all freight car draft gears as approved, nonapproved or obsolete, and the program has worked so well that during the 11 years it has been in effect about 700,000 cars, or one-third of the entire number of freight cars in interchange, are now equipped with approved draft gears. This should be a source of great satisfaction to the Mechanical Division of the Association of American Railroads, particularly in view of proof of the effectiveness of the plan in terms of the fine condition of cars which were built new, rebuilt or maintained with A. A. R. approved draft gears during this period.

The influence of these 700,000 cars has been to improve greatly the ability of the average freight train to get over the line without mishap regardless of great increases in weight and speed, which factors have enormously increased the intensity and frequency of end shock. The improvement is so pronounced as to afford definite promise that when all cars are provided with the better types of approved draft gears it will materially reduce the number of break-in-twos occurring on freight trains and this is already apparent on account of the great amount of work being done on draft gears, couplers and attachments.

One of the surest ways to circumvent the extreme wear and tear of the present service is to accelerate our draft gear and attachment maintenance programs. Two-thirds of the total ownership in interchange are still equipped with draft gears of the nonapproved and obsolete types. Fortunately, nearly all of these cars have the standard A. A. R. pocket size, and the vital question of eliminating excess slack and improving efficiency is solved by merely applying a modern draft gear. When this is done, it is good practice, of course, to be sure that the draft lugs, yokes and couplers are in good condition. The best maintenance policy is that which invests as heavily as possible in the best of the approved draft gear designs for replacements, scraps obsolete designs and spends money to repair only those designs known to be the best in the nonapproved list.

The A. A. R. is to be congratulated for its report D. V. 1048 of July 28, 1943, which candidly reviews the conditions on cars equipped with approved draft gears after 5 years of extremely heavy and high mileage service. This is one of the most important A. A. R. research documents in many years because it supplies the first official data from which the user of draft gears can evaluate type efficiency and select the design best suited for long-term service on the car. The committee found that in nearly all cases, involving nine different types of draft gear, both gears and draft attachments were in remarkably good condition with no evidence of approaching a worn-out condition. The performance data based on tests under the 27,000-pound hammer are most instructive. I am in hearty agreement with the modest statement in this report that "the whole program of certifying draft gears is having beneficial effects."—*F. H. Becherer, Superintendent, Car Department, Baltimore & Ohio.*

Conditions Which Require Further Study and Attention

Coupler and draft gear inspection and maintenance on the D.L.&W. is as follows:

1. To insure that car inspectors note the condition of the horizontal draft keys and attachments, the retainer end of the key is chalked with white chalk. Since this system was inaugurated more than a year ago, cross key failures due to keys losing out have been reduced to nothing.

2. All cars given program repairs in the major shop have their couplers and knuckles normalized.

3. All riveted yokes are attached to couplers at the major shop, where the rivets are machine driven and the gibs are set up to the coupler butt under the steam hammer.

4. All draft gears are dropped for inspection as the cars pass through the major shop for program repairs.

5. All bolts are eliminated from front and back carrier irons on all cars given program repairs. In some cases back carrier irons are welded; this is done to eliminate delays caused by the nuts working off the bolts.

6. Conditions and defects which should be given further study by the railroads are as follows:

The correction of the draft gear slack should be made a live subject by all roads.

There is not enough attention being paid to the drooping coupler, and this is one of our bad offenders, where breaks-in-two are concerned. Possibly the rule pertaining to coupler alinement and adjustment should be given further study.

Closer inspection should be made of vertical keyed couplers. Many defects exist in the coupler butt and shank that cannot be detected except by close inspection.

There is not enough progress being made in regard to changing out the No. 2 D lock lifters, and in many cases where they are changed the condition of stuck locks still exists, because the worn condition of the lock where it comes in contact with the top wall of the shank has not been corrected.

More attention should be given to the removal of the so-called push-down type release lever.—*K. H. Carpenter, Superintendent Car Department, D.L.&W.*

Car Inspectors Have Heavy Responsibilities

The American railroads are today facing the most crucial period of their existence and delays of any nature are a serious handicap. One of the frequent causes of delays is failure of couplers and draft gears. Because of heavier and longer trains, couplers and draft gears are subjected to a lot of punishment and therefore must be in good shape or failure will result.

As cars pass over repair tracks, careful inspection should be given couplers and draft gears. Couplers should be gaged for height and adjusted to proper height. A minute inspection should be made for cracks or checks which may cause failure. Inspect all coupler parts and renew all worn or broken parts. No. 1 or No. 2 D type lifters should be replaced with No. 3 lifters. Coupler operating levers and their attachments should also be inspected and repaired or replaced when defective. Many cars are equipped with the newer types of draft gears, but due to the pressing need for every available car, many cars are now in service with the older and weaker types of gears. Many failures result because of loose and broken yoke rivets, cracked and worn yokes, broken or missing springs, and broken or missing cross keys. All of these items should be watched closely by inspectors in train yards and on repair tracks.

As cars go through shops for classified or general repairs, all draft gears and couplers should be removed and examined and renewed or repaired, if necessary. Draft lugs, links and cheek plates should be inspected and repaired, if defective.

Particular attention should be given to coupler operating mechanism on AAR type D and E couplers with reference to the anti-creep feature. Many delays have been experienced in the past due to trains parting en route.

Another common failure is the coupler cross key working out because the retainer cotter key is missing, thus allowing the retainer to be lost.

These are all defects which we must rely on the car inspector to detect in regular train yard inspection. However, if these items are watched carefully as cars pass through shops and repair tracks, and all worn or defective parts renewed or re-

ft-Gear Maintenance

aired, we can materially reduce the number of delays to cars in service.—*F. E. Starr, Vice-President, Northwest Carmen's Association, St. Paul, Minn.*

Failures Due to Defective Couplers and Draft Gears

Our records indicate that of all the loaded cars shopped for repairs within the Chicago territory, about seven per cent are shopped on account of defective couplers or draft gears.—*C. J. Nelson, Superintendent of Interchange, Chicago Car Interchange Bureau.*

A Matter of Education

The coupler shank, body and parts, especially the knuckle and the back portion of the shank, should be carefully inspected for cracks. On cars going over repair tracks the contour of couplers should be gauged, renewing parts or coupler if necessary to restore the proper contour.

Draft gears and attachments should be given careful inspection at all inspection points, shopping the cars for repairs which are found to have excessive slack or visible defects.

Cars going over light repair tracks for any cause should have the draft gears and attachments closely examined. This does not require the removal of the draft gear for examination, except when parts are defective or there is excessive slack. The amount of slack can be determined by pushing the coupler in to take up all the slack and then pulling it out as far as it will go by means of a bar or lever. The difference between the two measurements taken from coupler horn to the striking plate will be the total slack. If the total slack is 1½ inches, examination should be made to determine the cause and repairs made. It may be the key slot is worn at the pulling point on coupler, coupler worn at butt, worn or broken coupler yoke, worn or bent draft key, defective draft stops or defective draft gear. In the majority of cases, the cause will be found in the draft gears.

On cars given program repairs, the draft gears, couplers and attachments should be removed from the cars, carefully inspected for defects and wear, renewing the part or parts necessary.

Defective couplers and draft gears removed should be shipped to a central point for reclamation, as better results can be obtained by having specially trained employees perform this class of work and there is less possibility of material being scrapped that could have been reclaimed by welding, etc.

Coupler heights should be watched closely, keeping the coupler in a level position as far as practicable, and maintaining the proper height since high and low couplers adjoining may cause a break-in-two in transit.

Draft keys, retainers and cotters are very important features in moving shipments without accidents. A very rigid inspection should be made for broken or worn cotters in draft key retainers and if found to be in a condition that would likely cause trouble, should be renewed, applying over-size cotters where possible, as the cotter hole in draft key retainers will be found worn in many cases.

Employees should be educated and trained to make proper inspection and repairs at all times to insure safe and rapid movement of cars to destination and to accomplish this feature we must have energetic, capable and thoroughly interested supervisors that they may in turn instruct the workmen and follow up to know that the employees perform their duties in a safe and workmanlike manner.—*J. G. Rayburn, Chief Car Inspector, C. & O.*

Gateway to Northwest in a Difficult Situation

The condition of draft gears on many freight cars is such as to constitute a serious handicap to safe and expeditious train operation, and that at a time when speed of trains and intensity of car usage call for a high degree of efficiency in these parts.

In the existing emergency older types of cars have been pressed into service without adequate conditioning work. They may be passable for short hauls but they constitute a hazard when handled in heavy fast trains. Among the most neglected parts are draft gears. About the only reason we do not have more disastrous accidents due to failure of these parts is that enough good gears are usually intermingled to at least partly protect these weak sisters. If you insist on running a bunch of these weak ones together in a heavy train better either pray or think what your alibi is going to be. Alibis, even though nice and shiny from overuse, still seem to be the vogue. Of course there still remains Hitler.

Maintenance has not kept pace with wear and tear, and far too few new cars have been added to take up the slack. Repair force shortage has also been a handicap. So, the more reason we should tighten our belts and keep at 'em. There appears a lack of concentrated effort in some quarters towards putting these parts in serviceable condition on empty cars; as a consequence loads have to be set out and are delayed. Closer inspection and better work on cars prior to loading, particularly with important or long haul loads, would help immeasurably. Couplers and draft gears are such important items that upkeep must be good.

To a considerable degree we are reaping a harvest brought about by past negligence, made worse by present heavy use of cars. Many owners apparently never did carry out a really effective draft gear inspection and repair program on their cars, simply giving lip service to recommended practice, hoping conditions would be better tomorrow. Mañana is the word.

To the roads serving the far Northwest coupler and draft gear condition is a grave problem since most of the loads received from the East and Midwest for westward movement are destined to the Pacific Northwest and are hauled in fast heavy trains over three ranges of rugged mountain; they have to be good. At our Minneapolis yard where these westward trains are made up it is necessary to set out many of these through loads because of old coupler and draft gear defects. In order to reduce to a minimum load delays and car-day losses three repair shifts are worked. But we need help badly from roads originating these loads as, obviously, we can't do it all here.

The neglect is so serious in some instances that the draft gear really serves only as a partial filler to keep the coupler from pulling out. Not only is such a condition dangerous, much more so when several of these shirkers are close together, but they also impose extra work on gears that are working as gears should.

Gear Not Good for Life of Car

With the open type adjustable-in-place gears the maintenance problem is quite simple as slack can be taken up easily and quickly; and because adjustments are easy those gears are usually in efficient condition and therefore do more than their share of work. We have a lot of trouble with other gears especially in the older cars. Indications point to a widely prevailing opinion that once a gear is applied to a new car it is good for the life of the car, therefore needs no further attention. Wish we really had gears like that. Draft gears are hard working parts and if they do what they are put in for wear and tear is to be expected. They are so thoroughly concealed that yard inspection becomes a combined acrobatic and X-ray feat.

It is regrettable that with most gears it

is impossible to make quick and easy adjustments for wear to keep the gear at or near top efficiency so that uniform and continuous good service condition can be maintained. It would not then be necessary to build into the gear an objectionable amount of preliminary compression making the gear harsh to small blows; then after this preliminary compression has been absorbed by wear positive slack begins. Much of our draft gear trouble is in design; the yardstick is wrong.

The function of the draft gear is to protect car structure and lading against all types of shocks, not just to see how long it will stay in place. Therefore wear and tear commensurate with work performed is to be expected, and they require more than passing attention. It is highly misleading also to judge the efficiency of a gear by its condition after a certain period of service as, obviously, a shirker will show up much better than one that is really doing what it was put there for, and inversely the gear that is really functioning will show more wear since it is not only doing its own work but is also doing the work of the slacker.

Questions Fundamental Design

I may be "sticking out my neck" here but I maintain that our draft gear requirements are wrong in that too much stress has been laid on their ability to take care of heavy shocks, overlooking the light, battering shocks, a thousand or more to one capacity-shock. These small shocks, if uncushioned, slowly but surely batter down the car structure, and are also injurious to the lading. Our data seems based chiefly on laboratory or special test performances without being tempered by an intensive study of actual service performances. More actual crawling under the cars by some of our expert investigators would help.

There is a widely prevailing opinion among practical field men that a gear with a compression that will respond to and cushion these small shocks, and still effectively take care of the heavy one is by far the best; however the draft gear manufacturers are giving us what we are asking for, but are we asking for what best serves our needs? As an illustration it is observed that, in a good test laboratory, on cars with separate rear draft stops equipped with some of the non-approved gears we seldom find loose draft stop rivets, whereas on cars with the same stop arrangement equipped with an approved gear, loosening of stop rivets often becomes quite extensive. The obvious conclusion is that the old gear, due to early stage compression softness, effectively cushions the small buffings, whereas the stiff approved gear passes these small shocks uncushioned to the stop rivets, and slow but sure shearing action takes place. Naturally the lading, draft members, bolster and bolster members and attachments also suffer in like measure. Maybe those gears didn't outlast the car, but they did a good job while they lasted. Most other parts of the car require repair attention, so why not draft gears? I do not advocate going back to the old gears but none-the-less some of the abandoned characteristic functionings of some of those should have been retained in the new gears.

High recoil is still as destructive and objectionable as it ever was. Too low recoil should be avoided, but other desirable features must not be sacrificed to attain what may be considered ideal recoil release. In actual service low recoil is far from being as serious a matter as would appear from laboratory tests.

Draft gears are hard working and much abused parts and wear and breakage are to be expected. A minimum of wear for a given amount of energy absorbed is a desirable goal. But a more concerted effort on the part of all concerned and less buck passing is needed.—*P. P. Barthelemy, Master Car Builder, Great Northern.*

Seven Causes for Failures

Most all coupler and draft gear failures may be attributed to seven common causes. These and the methods of correction are as follows:

1. Coupler cross keys losing out because of cross key retainer cotter keys wearing or losing out.

This condition can be corrected by closer inspection and maintenance of the retainer cotter keys or by applying a cross key retainer locking device, of which there are several on the market which have proved satisfactory.

2. Loose coupler yoke rivets and ends of yoke not properly lipped over butt of coupler.

All empty cars should be shopped because of this condition, particularly the loose rivets.

3. Carrier irons coming down because of loose or worn out rivets or bolts.

This condition should be corrected on all cars when empty.

4. Cross keys breaking because of excessive wear and fatigue.

This condition can be kept to a minimum if all second-hand cross keys applied are restored to correct size and properly normalized by heat treating.

5. Coupler yokes breaking because of hidden progressive fractures.

This condition may be kept to a minimum if all yokes are removed from the car and inspected when the cars receive semi-heavy repairs. Most cars receive this type of repairs in the home shop every four to five years.

6. Broken coupler bodies because of unusual handling and severe impact.

Many of these failures could be eliminated if all couplers over eight to ten years of age are removed from the cars and normalized by heat treatment. The results of extensive study of broken couplers develops that 90 per cent were over 10 years old. Also many broken couplers have been caused by the mishandling of cars in switching operations. This condition should be brought to the attention of all enginemen and switchmen to emphasize the importance of careful handling of trains and cars.

7. Broken draft gears.

All cars with excessive slack, which is indicated by wear on coupler shanks and marks on buffer castings, should be shopped when empty. Our experience with broken draft gears has been that most gears show worn and broken conditions of long standing; therefore, in our opinion most of the cases where shipments are delayed could have been prevented by repairing the car before it was loaded.

To keep couplers and draft gears in prime condition and thus eliminate failures en route requires a continual close inspection by train, yard and repair track forces on all railroads. I believe that if methods of correction as outlined above are followed, we will have considerably less coupler and draft gear failures.—*W. Harmison, Superintendent Car Department, Erie.*

The Problem Stated And Remedies Suggested

Coupler and draft gear failures rank second in road failures and third in terminal delays.

A great deal can be said on the characteristics of the automatic coupler, including the A. A. R. Standard E; also on draft gears, from the early spring design to the present A. A. R. certified friction draft gears.

The earlier types of automatic couplers were many in design. Each had its day and all had their inherent defects, which was primarily the cause for their elimination and the adoption of a standard coupler. However, some of the best designs survived for years and we still have many cars operating with the 5 inch by 7 inch shank couplers, also a few of the 6 inch by 6 inch shank couplers operating principally on privately owned cars. Due to sill spacing and draft gear pocket spacing, these cars will be with us for many years.

As the heavier types of cars came into use, provisions were made for the A. A. R. Standard D coupler with 6 inch by 8 inch shank; also standard draft gear spacings of 24⅝ inches and heavier gears, to meet the increased operating demands and line up with heavier couplers.

With the stepping up of these improvements, trains were modernized in length, cars were loaded more heavily, train speeds increased, and car switching methods were improved. During this transition period we cannot expect that the older and lighter designs of couplers, yokes and draft gears will survive in performance as well as those of modern design.

The type E coupler, having superseded the type D, is giving a much better performance and is far superior in design and operation. Also, the certified A. A. R. approved draft gear has climaxed the draft and buff operations in modern cars and will furnish maximum protection to car and lading with the present switching methods.

In the analysis of road failures, I find

that where unusual handling has taken place the fracture may be one hundred per cent new, or failure may have taken place from an old progressive fracture, perhaps of long standing. Where failures occur in normal handling, they are usually caused by a progressive fracture or a badly worn part.

Improper handling of the train by the engineer, or train handling over which the engineer has no control, usually finds the weak spot and generally can be traced to location in train, track layout or brake application.

Couplers, yokes and draft gear parts are susceptible to flaws, and failures usually occur just ahead of the coupler butt, through the key slot in shank, or head failure at lugs. Failures in the yoke occur at the back of gear opening, through housing at front lug, and at the front through keyway. Strap yokes fail at front lugs or in bends at the back; also, rivets may fail in butt.

Draft gears fail in the internal parts or through housing walls. The A. A. R. provides for removal of gears having free slack in excess of 1½ inch. Gears with such slack should not be in service, on account of train handling conditions and liability of derailment. This slack is termed a rubber neck coupler in normal operation.

Break-in-two of trains occurs when knuckle surfaces are wet and coupler is reaching the low point, especially with the 9 inch knuckle. Car bounce causes knuckle creeping on empty cars located near the head end of train; this condition, aggravated by excess headroom over coupler shank, aids the slipping over of knuckle. In testing for cause, jack the high coupler upward and the low coupler downward and measure from plane of top of rails to center of knuckle. The measurements will be surprising and you will wonder why they stayed together so well. When knuckles are wet and slippery and the distance from point of knuckle and guard arm approaches the worn limit, they very often pull apart. Coupler contour should be well maintained to avoid uncoupling.

Knuckle openings are primarily due to improper operation of the anti-creep feature in the coupler. Either the top lock lifter in the D coupler becomes worn, or the rotary type toggle in the D or E is missing or improperly applied. If the top operated lock lift of the D is a No. 3 and is worn so that a new No. 3 will not suffice for proper operation, try an E type knuckle in place of a D before attempting to remove the coupler.

To prevent car bounce and knuckle opening from this cause, truck spring snubbers will assist materially. Many times, cars will uncouple at certain track locations due to track irregularities. Surfacing of the track, or reducing the speed to a point below the harmonic action of the truck springs, will correct the condition. These conditions are more pronounced on loaded tank cars than on other types.

Uncoupling levers and their lock lifting appurtenances very often bind or render the anti-creep feature inoperative and result in uncoupling.

The 11 inch knuckle should be applied to all couplers for the purpose of preventing knuckles slipping over each other.

In the winter season, damage to couplers and yokes greatly increases in switching operations. This damage can be reduced by impressing upon those responsible the importance of opening knuckles properly.

If couplers on both cars are D type and knuckles are closed, the coupling impact will be quite uniform on both. If both couplers are E type, the effect will be similar. If the types D and E come together in closed position, the coupler head of the E will usually fail vertically through the center, due to the longer guard arm.

For better maintenance of couplers, draft gears and yokes, my recommendations would be:

1.—Older designs in use are susceptible to breakage due to their inherent weakness for present-day handling and should receive a periodic inspection.

2.—Adequate time for complete inspection of the coupler, yoke and gear should be provided for in the Interchange Rules.

3.—This work to be done at the time of periodic air brake attention, every 15 months.

4.—Cars equipped with A. A. R. approved draft gears, standard E couplers and A. A. R. cast-steel yokes to be inspected every five years and car so stencilled. Proper time for doing the work to be provided for in the Interchange Rules.

5.—When cars are on repair tracks for any work, couplers should be checked for proper operation and tested for anti-creep failure, knuckles gauged, and uncoupling arrangements properly adjusted. A charge should be provided in the Interchange Rules for this inspection. My reason for specifying a charge for this work is that if you pay for something, you will get something in return.—*P. J. Hogan, Supervisor, Car Inspection and Maintenance, N. Y., N. H. & H.*

Emphasizes Education on Proper Train Handling

Obviously, the matter of thorough inspection of couplers and draft gears, as well as all other vital parts of cars, is one that must be constantly and closely followed up by maintenance supervisors to assure that inspectors permit no cars to go forward with conditions making them unsafe for movement.

In spite of diligent inspection, many hidden coupler and draft gear defects are im possible to detect through visual inspection. Many parts containing such defects function for many years without causing trouble under normal conditions, and generally there is some abnormal reason, such as rough train handling, that will bring the defect to light and result in trouble.

I may be digressing from the matter in hand, but the point I am trying to bring out is that those charged with handling the cars have an equally important responsibility with those who must maintain them. Many failures now charged against defective material could be avoided through more aggressive educational measures by the operating supervisors on proper train handling.—*G. H. Wells, Asst. to Supt., Car Department, Northern Pacific.*

We Must Become More Draft Gear Conscious

Due to conditions created by the present emergency, every available freight car must be pressed into service. Consequently, there are many cars in service today equipped with obsolete draft gears and attachments which require close attention. To insure proper protection to the car and to the lading the draft gears and couplers, regardless of type, must be maintained in good working order for high speed operation in long heavy trains.

While records indicate that cars equipped with modern, certified gears show a good performance, the fact remains that no matter what make of gear is found on a car it can not be expected to function properly if repairs to other essential parts are neglected. The maintenance of draft gears and attachments is primarily the problem of the car owner. On page 142, Section L of the A.A.R. Manual of Standard and Recommended Practice, a provision is made for systematic inspection and maintenance of draft gears and attachments, which if followed, I feel confident will bring about better draft gear performances. Obviously, to attain the objectives sought requires concerted action upon the part of all roads.

Car inspectors in transportation yards and at interchange points should be trained to observe indications of slack draft gears which in many instances are apparent by the condition of the striking plate, carrier irons, excessive travel, etc. In short, a campaign of education should be instituted so our maintenance forces will become more draft gear conscious.

It is our experience that defective draft gears are often reported as the cause of trains parting, but upon investigation we find that the primary cause of the break-in-two was some other defect, as for example, coupler and yoke defect, slack due to worn coupler stops, spread sills, etc. Naturally, such conditions cannot be corrected by the application of new draft gears unless proper renewals of draft gear stops are made and the sills strengthened to withstand the shocks received in heavy train handling and severe switching operations.

Couplers must be maintained in good condition to insure proper operation of parts. A.A.R. Interchange Rules 18 and 20 outline a maintenance procedure for the care of couplers. Many defects, such as cracked coupler yokes and coupler shanks not visible in ordinary inspection in transportation yards can, however, be detected on repair tracks if a careful inspection is made before the cars are pronounced as o.k. and released for service.

Some officials have advocated that draft gears be subjected to periodical inspection and overhauling, the road having the car in its possession being obliged to do this work, billing the car owner for the cost

in the same manner as now obtains in the case of periodical air brake cleaning. I question whether any such action is necessary provided car owners give their own equipment the attention it requires. Co-operative effort would, without doubt, minimize draft gear and coupler failures.—*G. W. Ditmore, Master Car Builder, D.&H.*

Many Details Must Be Checked and Corrected to Avoid Failures

A. A. R. Rule 20, Section E, specifies that empty cars with a coupler height of 32½ in. or less shall be adjusted to 34½ in., or as near as practical thereto, but not exceeding 34½ in. Loaded cars measuring 31½ in. or less shall be adjusted to 33⅛ in., or as near as practical thereto, but not exceeding 33½ in. These requirements should be adhered to.

Rule 18 outlines the proper method of gaging the various coupler parts and also the procedure to follow for replacements of the coupler or any of the parts. It authorizes the replacement of the No. 1 and the No. 2 type lock lifter with a No. 3, whether or not the former two are defective; this because of the trouble that has been encountered with the D couplers having the No. 1 or the No. 2 lock lifter.

The bottom-operated or the rotary type E coupler is a decided improvement in coupler design, but sometimes we find that the lifter toggle for the D coupler has been used in an E coupler. When changing from D to E type couplers, the uncoupling lever is not always changed to suit the new requirements, particularly when both couplers are of the bottom-operated type. In such cases the E coupler requires a longer lever and when not applied we have a broken lever casting or distorted parts, and another delay is involved.

The proper angularity of the end of the uncoupling lever connecting to the coupler lift lever is most important.

A. A. R. Rule 3, Section C-7, specifies that the coupler operating lever connected direct with coupler lock or lift without the use of links, clevises, clevis pins or chains, shall be applied to all cars built prior to January 1, 1919. Most freight cars today are so equipped, but various metal devices are used and of utmost importance is the clearance or the travel this connection has between the uncoupling lever and the coupler lock or lift. Failure to have proper clearance or travel accounts for a large number of our train break-in-two's.

Draft gears with more than normal travel (so-called slack) are a common enemy of efficient train operation and this with improper type or improperly applied uncoupling levers is conducive of poor train operation.

Failure to maintain couplers within the specified heights, improper application or lack of proper maintenance of coupler operating appurtenances, and improper maintenance of draft gear travel appear to be the predominant causes of train delays, insofar as couplers and draft gear failures are concerned.

Coupler and draft gear manufactur give us good material. Car builders app them with proper design and good wor manship. Our train yard inspection for can only make minor adjustments or r pairs to coupler parts without causing u due terminal detention. They are, how ever, the key men to detect any coupl or draft gear defects, which may requi the removal of the car from the train t prevent en route failures. Adequate i spection includes the replacement of mis ing coupler key retainers, cotters, etc., an the assurance of secure draft gear an coupler carriers, as well as the detectio of defective coupler yokes. This make it imperative that our repair branch an shop forces maintain the draft gears an couplers, as well as their component parts to a standard that will obviate the delays en route.

The present urgency for material conservation would appear to justify full compliance with A. A. R. rules for coupler and coupler parts reclamation and the procedure to follow would warrant this work to be performed only by workmen well trained and qualified to do it.

The large number of inexperienced men, together with the labor shortage that confronts most of us today, would appear to justify consideration being given to the use of only qualified carmen at each repair branch or shop, to specialize on the inspection and authorization of repairs to draft gears and couplers.—*C. N. Kittle, Chairman, Executive Committee, Niagara Frontier Car Inspection Assn.*

* * *

(Office of War Information—Photo by Delano)

With the Car Foremen and Inspectors

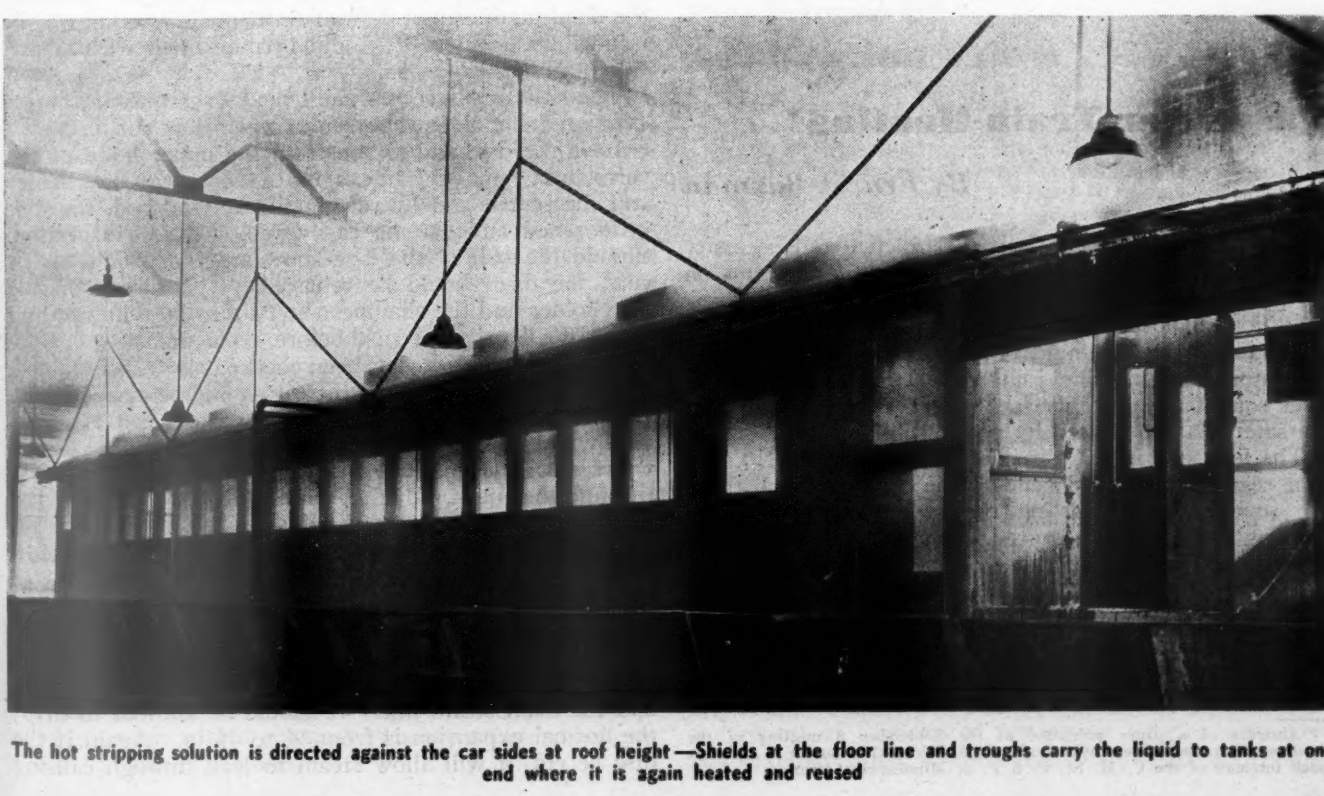
Reading Installs Paint Stripping Plant

Paint stripping operations on passenger cars and tenders have been speeded on the Reading since the installation of a plant using a hot chemical solution for paint removal. The plant is so designed that an entire car is stripped at one time and it replaces a smaller portable unit which was used experimentally for several years with good results. Before the use of the present method cars and tenders were sand-blasted and it required two men from three to four days to remove the paint from the outside of a car. Removing the paint and varnish from car interiors required an average of 54 hours and from six to eight men. Paste and liquid varnish removers were used and from three to four coats were required. Now, car interiors and exteriors are cleaned in one eight-hour shift.

The new plant is installed in a separate well-lighted and ventilated building on the shop property. The working location is on a pit track. The hot solution tank and a settling tank for the drainage from the car are located in the pit together with necessary piping for steam, water, drainage and the leads to the spray pipes. Drainage is directed to the end of the pit in which the settling tank is located.

When a car is spotted in the shop it stands between two rows of pipes which run along each side at approximately the height of the eaves. These pipes are perforated at intervals of a few inches, one pipe on each side carrying hot solution at pump pressure and another carrying clear water at main pressure. The hot stripping solution is carried in the lower pipe and fresh water for rinsing in the upper one. The solution, a mixture of Oakite stripper and water, is heated in the mixing tank

Track pits accommodate solution tanks and piping



The hot stripping solution is directed against the car sides at roof height—Shields at the floor line and troughs carry the liquid to tanks at one end where it is again heated and reused

Appearance of car after paint has been removed—Interior and exterior cleaning requires eight hours

by live steam to a temperature of about 180 deg. F. Directed against the car sides at the eaves, it runs down them to troughs on the floor where it moves by gravity to the settling tank from which it is reused. The car ends, vestibules and car interiors are cleaned by the use of portable spray rakes connected by hoses to outlets provided in convenient locations.

Wooden interior finishes are not cleaned by this method but otherwise all passenger cars and engine tenders pass through this plant when undergoing repairs which include repainting. In addition, standard box cars being prepared for express service in passenger trains have been stripped of freight-car paint coatings with this new shop facility.

Passenger Train Heating*

By Ernest Baxman

At this time of the year, it is the practice and necessity of every railroad to try and have the heating systems on all passenger equipment in the best possible working condition so as to eliminate freeze ups and the excessive amount of steam blowing from improper setting of steam regulators and metallic joint connections. The objectives sought are not only fuel conservation but avoiding the safety hazard caused by poor visibility.

The first step in this direction is to check the No. 440 heat regulator, situated beneath the car—of which there are several, depending on the type of car—and the amount of radiation required. The No. 440 regulator is in fact a feed control valve, consisting of a slide valve situated in the upper body of regulators. A weighted rod is located within a tube of casing below which is a diaphragm which, when expanded by the return of the condensate and vapor from the valve within the car, raises the vertical push-rod, shutting off of the steam; when the diaphragm cools, the weight of the rod again opens the valve. A removable disc is held in place by a disc holder and screen; against this the push valve is seated, when in the off position.

The first step in creating a perfectly operated regulator is to close the No. 124 or vented shut-off valve situated between the regulator and the main steam line. Then remove the diaphragm from the lower portion of the casing. This diaphragm should then be placed in hot or boiling water to test its expansion qualities. Should the diaphragm expand and not return to its normal position, the metal is dead from age, and should be replaced; the same would be true if the diaphragm did not expand on account of leakage of fluid from the diaphragm. Shaking the diaphragm cannot determine its quality, as its weight is no telltale unless it should become filled with water, which seldom happens.

The disc and screen should next be removed for inspection for a clogged screen or a worn or cut disc. To remove the disc and screen from the upper body of the valve, first remove the hexagon cap, then the disc holder and the screen and by raising the vertical rod, the disc is loosened and can be easily removed for inspection. Should the seat of the disc show any signs of wear or cuts, the disc should be replaced. The screen on the disc holder and the chamber should also be removed and freed of all grit and rust before replacing.

After the regulator has been checked and re-assembled, the floor heat valve within the car should be placed in the off position, creating a short circuit between the regulator and floor valve, thus eliminating the unnecessary waste of time and steam in waiting for the steam to pass through the entire radiation within the car. The No. 124 or vented shut-off valve should now be opened. After the steam has made its first circuit and continues to blow excessively, the adjusting nut below the hinged cover of the regulator casing, should be drawn up to where it shuts off, but not any more than to this point, so as not to have a tight regulator resulting in freeze ups due to the condensate forming in the line between the regulator and the main steam line. It should be allowed to drip; the normal expansion is from 1/4 to 3/8 in. Again if the disc be cut, it will allow steam to leak through causing

* Abstract of a paper presented at the September 8 meeting of the Northwest Carmen's Association at St. Paul, Minn. The author is assistant coach foreman of the C. M. St. P. & P. at Minneapolis, Minn.

a freeze up between the regulator and the valve within the car. The practice of placing a washer or two between the diaphragm and the push rod should not be permitted as it is one of the greatest causes of freeze ups due to improper operation of regulators.

Most trap or regulator freezing is on cars toward the rear of trains and all yard forces should be cautioned not to set the regulators too tight. If the steam continues to blow after adjustment, it is an indication that the disc is cut or worn and is in need of renewal. One should always bear in mind that turning up the adjusting screw for the diaphragm will not help a bad disc to seat itself.

The automatic heat valve inside the car, whether for overhead heat or floor heat, should be dismantled at the beginning of each heating season and cleaned. Worn parts, such as wings, packing and stems should be replaced, the worn parts usually being reclaimed. One of the greatest causes of sticking heat valves is the improper setting of the regulator underneath the car. Some are too loose, causing a pressure on the wing and packing and others too tight, not forcing the condensate out of the valve. Of course, grime and dirt also cause a part of this trouble. At first, we had trouble with the improper use of tools on the bonnet and stuffing nut—such as use of pipe wrenches in removing the stuffing nut to check the condition of packing. The wrench would dent the brass, causing the dent to impress itself onto the ferrule of the packing, thereby binding itself onto the stem and causing the valve to stick. Or, if the packing is of the carbon type, it may break. Some roads lubricate the packing, but that is only a practice of the individual road and not a general practice.

Under no condition should sand or emery paper be used on cleaning any part of a heat valve or regulator, as it has a tendency to roughen, causing grit and grime to collect on the parts involved. (A dry rag or some kerosene can be used but should be wiped out dry.) Another cause for sticking automatic heat valves is improper setting of the compensator handle not allowing the switch to be thrown before the armature has been pulled completely over by the magnetic coils.

When a locomotive is attached to the train, the steam is dryer and also of greater pressure, so that traps should be adjusted again, if required, due to the higher pressure of steam. Most of the men when calling for steam from the engine crew do not specify the amount of steam required, or do not know the amount of pressure needed. Usually, this results in full boiler pressure which causes regulators and steam metallic joint gaskets to blow—which they did not while on the coach yard steam. This causes the unnecessary changing of gaskets and adjusting of steam traps, which would not have had to be touched, had the proper amount of steam been called for. In cases of this kind, should the regulator be tightened and later steam reduced, the result would be a tight regulator and more frozen traps. If the carman or steam man should ask for steam, a figure of 7 lb. loss per car would be a conservative figure by which to work.

In recent years, a No. 244 constant-pressure valve has been inserted in the feed line directly ahead of the regulator and is set at from 35 lb. to 40 lb. pressure when tested at from 70 lb. to 75 lb. main-line pressure. The purpose of this valve is to distribute a uniform pressure at all regulators as otherwise you may have boiler pressure at the regulator and to control this excessive amount of pressure, the traps would have to be drawn up, but would not remedy the entire amount of excess blow.

Again, I refer to the necessity of asking for nearly correct amount of steam from the engine crews, as too much pressure even with a constant-pressure valve will create a blow at the regulators.

In the latest type of valve using the same upper body as the No. 440 regulator only, the lower diaphragm and vertical rod are replaced with a bellows valve assembly; both are known as the economy diaphragm enclosures and are very sensitive, allowing the condensate and a slight blow at the first application of steam. From then on, only condensate will appear, still supplying the same amount of steam to the interior of the car. It is the closest to fool-proof of any valve now being used as there are no adjustments to be tampered with.

The same test and inspection of bellows should be made as with the diaphragm of the 440 type. If the bellows expands when placed in hot water and retracts to its normal position, it is in good order, but should it fail to retract, then it is out of order. If a blow continues on a regulator of this type, then examine the seat of the valve assembly at the top of the regulator for cut or worn seat.

There seems to be no end of defects laid to corrosion and worn parts such as with metallic steam connectors, mostly at coupler-head gasket seats, where rust accumulates and breaks off, allowing a gap between the gasket and the seat, causing a blow, which the layman usually tries to eliminate by hitting the coupler head; or the arm of the coupler head may be worn so that the locking device is loose, resulting in opening of couplers when the equipment is moved. Then as a rule, washers or wooden wedges are brought into play as a temporary measure, still not resulting in a definite cure; whereas if at the time the coupling is made the condition of the locking would indicate a worn coupler, that should be replaced in the yard and not along the main line, causing unnecessary delays due to careless workmanship.

The end valves by all means should not be forgotten. They should be repacked when required and the packing nuts set sufficiently tight so there will be some tendency to resist accidental closing of the valves in case the operating handle is struck by some flying object.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Improper Tank Car Anchorage Does Not Relieve Handling Line of Responsibility for Damage

Car SHPX 21904 was received by the Terminal Railroad Association of St. Louis in interchange at night. The following day it was discovered to be leaking and to have other damage, the tank having shifted on the underframe. A joint inspection certificate was submitted to the Terminal Company with a request for a defect card in accordance with Rule 44, Item 5. The defect card was refused. The owner claimed mishandling and stated that the car should not have been accepted if it failed to meet the A. A. R. Tank Car Specifications. The Terminal Association claimed that the defects originated in ordinary handling of the car and were the result of improper anchorage conditions. Their position was supported by the report of a group of competent carmen who were unable to determine whether the anchors had carried bolts

or rivets or a combination of the two. The report indicated that improper design and not wear was at fault.

In a decision rendered April 22, 1943, the Arbitration Committee found that, "Handling line is responsible under Section 10 (d) of Rule 32 and Section (5) of Rule 44." *Case No. 1795, Shippers' Car Line Corporation versus Terminal Railroad Association of St. Louis*

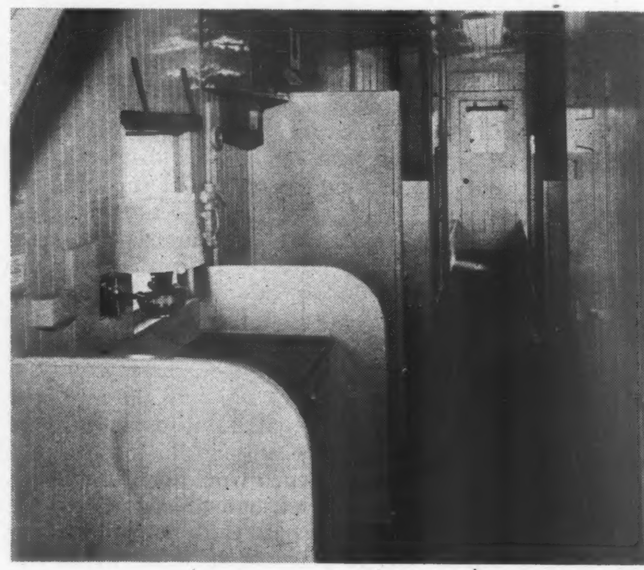
Western Pacific Caboose

*By A. G. Perkins**

Increased wartime freight traffic developed a need for caboose cars on the Western Pacific which, at first, was met by the installation of hastily equipped obsolete box cars. Such makeshift cars were not satisfactory and the California Railroad Commission cooperated with the management and mechanical department of the Western Pacific in the designing of a caboose car to be rebuilt from retired box cars. The equipment chosen were 40-ft. cars of 80,000 lb. capacity. They had steel underframes, steel truss side frames and a continuous center sill of even width which permitted moving trucks inward more than two feet to provide clearance for the wide, low coach-type steps which were added at each end of the car.

Rebuilding of the sample car, and 28 others since built, was done at the Sacramento shops of the Western Pacific. An operating test trip was made with the sample car which was participated in by representatives of the Western Pacific, Southern Pacific and Atchison, Topeka & Santa Fe, the Railroad Commission and members of the operating brotherhoods. Performance was satisfactory and the bay window arrangement impressed everyone favorably. While the bay window feature has been adopted by some eastern lines, the Western Pacific is the first western railroad to place this type of caboose in operation. In addition to eliminating the personal injuries sustained by trainmen in cupolas and while moving into or out of them, the bay window enables trainmen to observe the operation of the train better, pick up train orders and messages through the side windows while seated and braced in their seats, detect the odor of either hot boxes or wheels and observe sparks from damaged equipment. The conductor, while at his desk, also maintains closer contact with trainmen who are riding in bay seats.

There is a roomy conductor's desk which is provided



The car interior is painted in light colors—The conductor's desk has a shaded lamp—The floor covering is roofing paper glued to wood flooring

* Associate Safety Engineer, California Railroad Commission, San Francisco, Calif.

Bay-window caboose rebuilt from a 40-ft. box car—Truck centers were moved inward to provide clearance for platform steps

with strong bulkheads to prevent injury from slack action. Two bunks, with overhead bedding lockers are located at each end of the car. Roomy clothes and equipment lockers are also provided. There is a spacious ice box. A standard reversible coach seat is installed in each bay. A drop table can be lowered in front of the seats for serving meals.

The car trucks were of the arch-bar, coil-spring type but have been converted to an elliptic spring arrangement. Chafing plates were welded to both the faces of the column posts and bolsters to take up slack. Cast-iron wheels

Reversible coach seats are installed in the bays—Drop table serves as door for cupboard space when not in use

with ground treads are used. It is expected that these trucks will later be replaced with a pedestal-type truck when materials are more freely available and, with this in mind, the body bolster was moved sufficiently toward the center of the car to permit installation of such trucks.

The caboose meets with all Interstate Commerce Commission specifications.

Air Brake Questions and Answers

Installation and Maintenance of Axle Generators

230—*Q.—Give the duties of a locomotive unit parts.* A.—(Continued from December issue) The D-22-ER control valve corresponds with the D-22 AR and the D22-BR control valves inasmuch as the service and emergency portions are identical and interchangeable, however, the pipe bracket differs and a filling piece is interposed between the pipe bracket and the service portion, the operation of which will be described later. The F-1864 relay valve and the combined displacement, auxiliary and emergency reservoirs have been described previously. The M-2 brake application valve consisting of a pipe bracket to which are attached an equalizing piston valve portion and an application portion functions as follows: the equalizing piston valve portion controls the rate of brake pipe reduction in first service and service positions of the MS-40 brake valve. The application portion produces a safety control service brake application if the foot valve pedal and MS-40 brake valve handle are released simultaneously without a predetermined locomotive brake application in effect. A cut-off valve, located in the pipe brackets cuts off the air supply to the brake pipe when a safety control brake application occurs. The "C-2" diaphragm cut-off valve, the "C" diaphragm foot valve, the ½-in. choke fitting (1/16-in. choke), the volume reservoir, and the ⅜-in. check valve with choke are devices which comprise the safety control system and which operate in conjunction with the M-2 brake application valve and a pilot valve controlled by the MS-40 brake valve handle and located at the top of the brake valve. The operation of these devices is described later. The B-1 sanding valve and reservoir, ⅜-in. check valve and ½-in. choke fitting are parts of the sanding equipment which provide for automatic sanding of the rails during an emergency brake application for a limited time, sufficient for a train stop but which prevents unnecessary waste of air and sand. The C-1-20-8 strainer and check valve provide the dead engine feature, by which the second main reservoir on the locomotive is charged from the brake pipe when the locomotive is hauled dead and air compressors are inoperative.

Carrier for Journal Boxes

Safe handling of passenger-car journal boxes is assured in the Jersey City passenger-car yard of the Erie by the use of a U-type carrier developed by J. E.

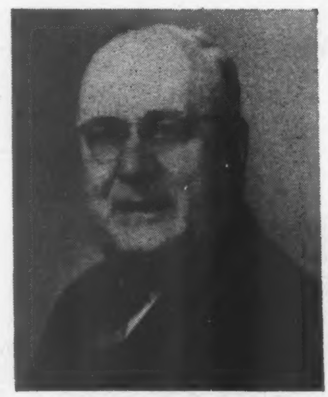
A journal-box carrier which can also be used to lift boxes when wedges and bearings are being removed

Dougherty, assistant general foreman. A piece of plate steel of the required size is properly shaped and provided with pipe handles welded in place. It can also be used to raise a box while wedges and bearings are being removed or replaced. Because the box is held firmly in place in the carrier the danger of scoring journals when boxes are removed is eliminated.

Efficient Methods of

Boiler Washing and Filling

Committee of the Boiler Makers' Association presents review of methods of servicing locomotive boilers adopted for increasing both firebox and staybolt life



B. C. King,
Chairman

EFFICIENT washing and filling of boilers was one of the topics on which a committee report was prepared for the 1943 year book of the Master Boiler Makers' Association. The full report of the committee included a summary of the replies received from 55 railroads to a questionnaire relating to practices in washing out boilers and to the facilities which they had available for such work. The formal report of the committee as a whole was supplemented by six separate papers submitted by individual members of the committee. Because these papers deal specifically with practices on six separate railways with relatively little overlapping, abstracts of them are presented herewith rather than a summary report of the committee as a whole.

The members of the committee to whom this subject was assigned were B. C. King (chairman), general boiler inspector, Nor. Pac.; R. W. Barrett (vice-chairman), chief boiler inspector, Can. Nat'l; H. A. Bell, general boiler inspector, C. B. & Q.; A. P. Robertson, general boiler inspector, Grt. Nor.; W. B. Graham, chief mechanical inspector, Mo. Pac.; A. W. Novak, general boiler inspector, C. M. St. P. & P.; J. G. Kenny, general boiler foreman, W. & L. E., and E. E. Owens, general boiler inspector, Union Pacific.

Cold-Water Method Used on Canadian National

By R. W. Barrett

Chief boiler inspector

The Canadian National for the past two decades has carried on the practice of cooling down and washing boilers by the cold-water method. The results obtained by this method, the length of service received from the firebox sheets, and the mileage made between retubings fully justified the continuance of this mode of procedure.

To carry out the cold-water method of cooling advantageously enginehouses should be equipped with a cold-water delivery line and a blow-down pipe line connected to a hot well. A permanent 1¼-in. angle valve connected to the top of the boiler at the front end or on the top check for a cold-water inlet and a 1½-in. angle valve connected on or near the dome for a hot-water or steam outlet are required. Suitable hose connections to couple the cold-water feed to the cold-water valve and the blow-down line to the hot-water outlet valve are also needed.

If the engine is under steam pressure, the inspirator is to be operated until the boiler is completely filled or the inspirator breaks. The hose from the cold-water line must then be attached to the 1¼-in. filling valve. The blow-down hose must be attached to the 1½-in. cooling-down or outlet valve and connected to the shop blow-down line or, where the shop is not equipped with such a line, the blow-down hose shall be set to discharge into the pit. Cold water is then run into the boiler and continued until it is cooled down so that the back of the bare hand can be held comfortably on any part of the firebox sheets. Water can then be drained from the boiler through the blow-off cocks but in no instance should the boiler be cooled down or filled up through the blow-off cocks.

The time required to cool down boilers from the moment they are housed until they are ready for washing out varies from 2½ hours for small power to four hours for large locomotives. Tests were made at two large terminals and actual consumption of water was metered for cooling down, washing out and filling boilers on 38 locomotives of various classes. The average quantity of water used was 12,967 Imp. gal. Approximately two thirds of the cooling-down water is returned to the hot well and used for washing out.

It has been argued that cold-water cooling is detrimental to the firebox sheets and will reduce the service

period of this material due to rapid contraction, resulting in fatigue checks and cracks, breaking of staybolts, etc. This has not been the experience of this railroad. The average life of our firebox sheets is as follows: crown sheets, 20 to 25 years; tube and door sheets, 8 to 12 years; side sheets, 6 to 10 years.

Road and Terminal Blowing Stressed on Missouri Pacific

By W. B. Graham

Chief mechanical inspector

At all terminal points on the Missouri Pacific forces must blow out one-half glass of water from the left blow-off cock and one-half glass from the right blow-off cock, inbound. The same amount of blowing is required on outbound movement. In addition to blowing from the side blow-off cocks the terminal forces are instructed to blow one-half glass of water from the belly blow-off cock on outbound movement.

Blowing instructions also provide that sufficient blowing must be done on the line of road to prevent boilers from foaming. Enginemen are required to blow boilers not less than one minute each hour when using a muffler blow-off cock, and 30 seconds each hour when using open blow-off cocks. Blow-off cocks discharging through mufflers are held open 10 seconds for each blow alternating from right to left as many times as may be necessary and conditions will permit. Blow-off cocks without mufflers are held open 5 seconds for each blowing, alternating from left to right as many times as necessary. Terminal forces are held responsible for delays due to boilers foaming less than 20 miles out of terminals. Outbound blowing is done as near the departing time as possible.

Engineers are held responsible for delays due to boilers foaming when more than 20 miles out of the departing terminal. When changes in engine crews are made on extended engine runs, the engineer arriving is held responsible for delays due to foaming for the first 20 miles beyond the point of relief, after which the engineer in charge is held responsible for delays. At outside points, where engine watchmen are employed, the engine crews are required to do the terminal blowing.

The assistant engineer of water service is held responsible for checking all boiler water conditions at terminal points as indicated by dissolved solids. To accomplish this he makes regular tours of inspection and collects and tests water samples from locomotive boilers both inbound and outbound at engine terminals, reporting the results to the chief chemist. Boilers are not washed more often than once each thirty days.

Most of our water stations have treating plants and the treatment of water together with the proper blowing of boilers has made a big improvement in the condition of our fireboxes, boilers and flues. We run all of our flues the full length of four years and in some instances have been granted one year extensions by the Federal Inspection Bureau. It is estimated that, since improved methods were adopted, we have increased the mileage 100 per cent on all classes of power. On our large power which makes long runs and high mileage the flue mileage has increased 150 per cent.

We have hot-water plants for washing out and filling up boilers at all principal points on the system. This method has also extended the life of fireboxes approximately 100 per cent.

Hot-Water Plants and Steaming System on the U. P.

By E. E. Owens

General boiler inspector

We have equipped enginehouses at Council Bluffs, Iowa, Denver, Colo., Cheyenne and Green River, Wyo., with the F. W. Miller Heating Company's blowing, washing and filling system with the modified steaming arrangement. Savings in boiler maintenance can hardly be figured in money as yet but the life of flue-sheet knuckles and firebox sheets is being extended. For instance, the life of top flue-sheet knuckles on heavy power has been extended 30 per cent. Before we had direct steaming at Cheyenne and Council Bluffs it was necessary to renew the top knuckle flue sheet on 4-8-4 locomotives having a boiler pressure of 300 lb. in seven to eight months, or at approximately 100,000 miles. We are now getting 150,000 to 200,000 miles before there are any indications of cracking. Staybolt breakage has also decreased and side sheets are going from shopping to shopping with fully 50 per cent less leakage. Formerly, we had to patch the sheets to make them run out the flue mileage.

Using one of our new 4-6-6-4 locomotives as an example, our procedure when the engine comes to the house is, first, to test the boiler water. If total dissolved solids run over 150 the boiler is blown. Before it is entirely dead, water is turned into the boiler. At the pump the temperature of the water is from 160 to 180 deg. F. This water passes through a modified filling valve, or chamber, into which steam is turned from the house line, which raises the temperature of the water entering the boiler to as high as 300 deg. F. depending upon the volume. There are three valves which control the flow. One of these permits a flow of 50 gal. per min. and when this valve is used water temperatures range between 300 and 330 deg. as it enters the boiler. We call this the slow-filling process and it takes between 1½ and 2 hours to fill to the bottom of the glass. Gauge pressure at this level will be between 40 and 60 lb. Water is then turned off and steam turned on. In 30 to 45 minutes there will be between 2 or 3 in. of water in the glass and 90 to 100 lb. of steam on the gauge.

If it is desired to hurry operations either a 75- or 100-gallon-per-minute valve is opened. The temperature of the water entering the boiler drops accordingly but not below 250 deg. F. While the boiler is filled more rapidly pressure does not build up as fast and the time saved in filling is about evened up by the time the live steam brings the pressure up to 90 or 100 lb. after the water is turned off.

Total dissolved solids are reduced to 80 grains or less on all engines leaving home terminals which means that some boiler water must be replaced with fresh water. Our old system of raising to working pressure and then blowing out two to four glasses of water was the cause of much staybolt leakage and breakage. We now hook the blowoff cock up to the line and blow out a large part of the water in the boiler, depending upon the steam pressure when blowing started. We blow a boiler down from 150 or 175 lb. to 90 or 100 lb. in 20 to 30 minutes, fill through the modified steaming valves with water between 280 and 300 deg. F. in 30 to 40 minutes and then have 100 to 110 lb. gauge pressure with total dissolved solids reduced to between 35 and 50 grains and the engine is ready to go. In nine cases out of ten engines are out of the house in an hour or less.

Tests conducted recently at Huntington, Oregon, developed that the blowing down, washing, re-filling and firing of heavy freight and passenger locomotive boilers can be accomplished in not to exceed 5½ hours. Formerly 6½ to 8 hours were required before the installation of the Miller modified steaming system. Five to 6 hours were required to blow down for water change and fire to operating pressure; with the new system this time is reduced to 2½ hours. It is conservatively estimated that these modified steaming systems have increased the availability of Union Pacific heavy freight and passenger power by eight locomotives and that the system to be installed this year will further increase that availability by two locomotives. Considering the fact that each of these locomotives will average 6,000 road miles monthly, the increased availability represents 750,000 locomotive miles annually as a result of reduced terminal handling time.

Sequence of Operations On the Great Northern

By A. P. Roberson

General boiler inspector

When boilers are cooled down for washing, the steam is blown from the boiler through a 1¼-in. syphon cock connection on the steam dome and into the blowdown line of the Miller hot water washout system. After the steam pressure has been reduced to practically zero, cold water from the enginehouse line is run into the boiler through the same connection at the steam dome and water in the boiler gauge glass is never allowed to be out of sight while cold water is being put in. During this process of cooling, the blowoff cock is opened to permit circulation of the cold water with that of the hot and the procedure continued until the temperature of the boiler water is about 120 deg. F., or the same as that of the washout water to be used. The time consumed in this cooling process is approximately five hours.

When the boiler has been washed, the necessary inspections and repairs completed, it is filled through the injector delivery pipe with water at a temperature of preferably not more than 160 deg. F. and is fired up and steamed slowly. In addition to this, to increase circulation and uniform heating of the entire boiler of the Mallet-type locomotives, steam through a 1¼-in. line is admitted to the boiler at a cock located in the bottom of the boiler near the front end.

When necessary to drain boilers for any reason, the following procedure is indicated:

1—Reduce steam pressure through the dome syphon cock connected to the refill-tank line. Reduce boiler pressure below that of the cold-water pump.

2—Connect the cold-water pump to the dome syphon cock. Start the pump. At the same time start the circulating pump connected to the rear blowoff cock and discharging into the wash-water tank.

3—Circulate cold water until the steam pressure is off.

4—Fill the boiler to the top by stopping the circulating pump and test the units.

5—Lower the water level to the top of the glass. Resume circulation until the wrapper sheet feels cold to the hand or the water temperature is 120 deg. F.

6—Stop the cold-water pump and drain the water from the boiler until the crown sheet is exposed. (Plugs can be loosened but not removed as soon as the steam pressure is off.)

7—Start washing immediately, removing one plug at a time and replacing it before another is removed. The crown sheet is to be washed first.

8—Better results are obtained by flooding the boiler with a large volume of water rather than a small volume at high velocity. This is particularly true when washing flues.

9—Corner firebox plugs and belly plugs are removed last and not until all higher plugs have been replaced. Water is removed from the boiler with a circulating pump.

10—A choke should be placed in the house blower line to prevent too rapid firing up. When sufficient boiler pressure is obtained, firing can be completed with the locomotive blower.

11—The time required to reduce pressure, precool and wash is six hours. Time to fire up should not be less than three hours. Total time for all work will be not more than 12 hours.

12—Under present operating conditions there is no valid reason for washing or changing a boiler oftener than on inspection. It may be necessary to reduce pressure to work on appurtenances but it is not necessary to drain the boiler. If concentrations are maintained below foaming and water is conditioned so as not to precipitate down scale, there is no need to drain or wash the boilers.

High Pressures Create New Water Problems on Milwaukee

By A. W. Novak

General boiler inspector

Through the installation of lime and soda treating plants, with proper settling facilities at points where sludge accumulation was a factor, the installation of wayside water-treating units at all other points supplying locomotive feedwater on the Chicago, Milwaukee, St. Paul & Pacific, and the employment of hot-water washout and refill systems at all principal points charged with the washing of boilers, it became possible for us to obtain from boilers ranging up to 225 lb. in pressure a washout period of from 10 to 30 days. A full term of flue service in all but a few isolated instances was obtained, as was a performance of firebox sheets that fully met expectations. Few defects occurring in boiler shells or wrapper sheets that could be attributed to a water condition. With the introduction of locomotives using boiler pressures of from 285 lb. to 300 lb. it became apparent that the washout periods, type and method of water treatment and care in handling of boilers preparatory to washing which adequately met the needs of low-pressure boilers fell far short of meeting the requirements of modern high-pressure locomotives.

In an attempt to improve the boiler conditions of the high-pressure locomotives the Milwaukee has replaced the wayside water-treating units at points where these locomotives take water with lime and soda plants that have sufficient capacity for the settling of water. Using all treated water, the washout period for these locomotives has been set at two weeks until such time as it has been proved that a longer period will not be harmful. The time element for the operation of cooling down, washing and firing up of locomotives is set at 12 hours; that is, an engine due for washing cannot be dispatched from the terminal until 12 hours after its arrival time at terminal.

In preparation for washing and to avoid the harmful

effects of rapid cooling, boilers are first subjected to a cooling-down process by means of a circulating system which is an integral part of the hot-water washout system. High-pressure freight locomotives, which have a boiler pressure of 285 lb. arrive in the enginehouse, after having the fires knocked, with pressures ranging from 200 to 225 lb. Soon after the engine is placed in the house a steam line from the blow-down line of the hot-water washout plant is connected to the boiler at the dome location whereby the steam in the boiler is permitted to vent itself. When the steam pressure has been reduced to 50 lb. or under, which requires from 45 minutes to 1 hour, the washout line from the hot-water washout system is connected to a fitting in the delivery line, permitting washout water at a temperature of from 150 to 190 deg. to enter through the boiler check and completely fill the boiler. When the boiler has been filled circulation begins through the blow-down line connected at the dome. Circulation of washout water through the boiler continues for a period of 30 to 45 minutes, after which it is felt that the temperature of the boiler and firebox sheets have been reduced to the temperature of the washout water passing through the boiler. At this time the blow-down and washout lines are disconnected from the dome and delivery pipe and as there is no pressure in boiler a suction pump is connected to the blow-off cock at the mud ring and the water drawn from the boiler and sent back to the hot-water washout plant through the blow-down line. Draining the boiler by this method requires about 45 min.

On completion of the cooling-down process, the washout plugs are removed from the boiler and washing begun. The time required for actual washing of boiler is dependent on the number of men employed in the washout crew. With four men employed, using two washout lines, it requires approximately 4 hours properly to wash and plug up the heavy type of high-pressure freight locomotive.

When washed, the boiler is allowed to remain empty until two hours before the engine is to be dispatched. It is then filled with refill water from the hot-water washout plant having a temperature ranging from 150 to 190 deg. F.

Care is taken when firing up the locomotives after washout or water change to make certain that the pressure build-up is not too rapid. Requiring one hour to raise the steam pressure from 0 to 125 lb. after the boiler has been filled with water at a temperature of from 150 to 190 deg. F. appears to be within a safe limit.

Planer Safety Device

For machining large parts which have considerable overhang when set up on an openside planer, the outer material rest, shown in the illustration, is used at the Chicago shops of the Pullman-Standard Car Manufacturing Company. This material rest consists of a narrow I-beam bed section, equipped with top rolls and located parallel with and about 2½ ft. from the main bed of the openside planer. A narrow box section table moves back and forth on the rolls, being actuated by connection to the work which is set up and bolted to the main planer table.

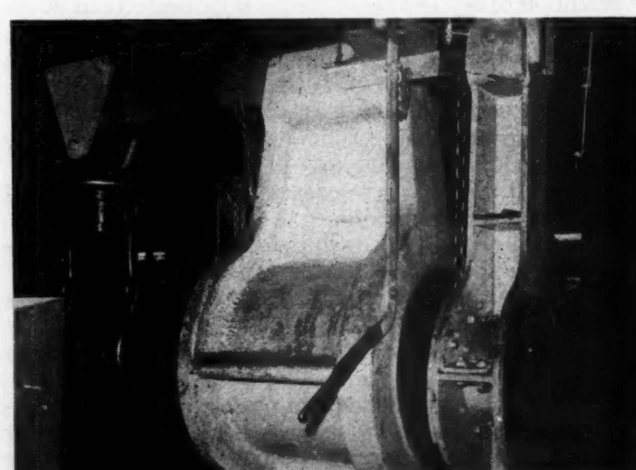
Experience indicated that the auxiliary narrow material rest or work-support table might and would fall

Stop applied to outer material rest of an open-side planer to prevent over travel which would cause the narrow auxiliary table to tip off the rolls

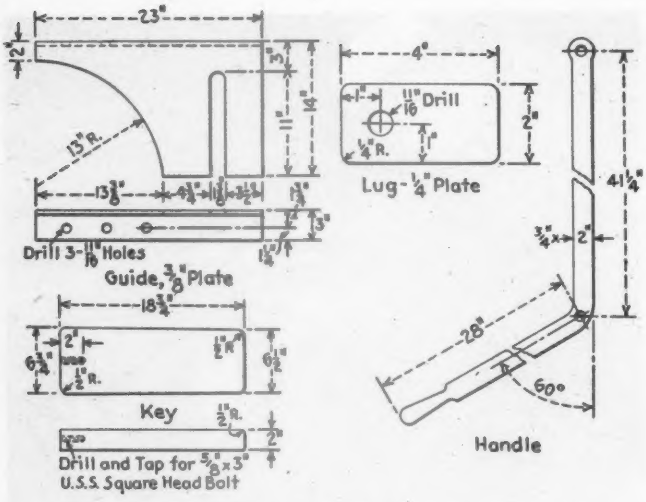
off the rolls if extended too far in either direction, thus constituting a potential hazard and unsafe condition. In the interests of safety, therefore, short sections of 3-in. angles are welded to the table and to the outside roller-positioning bar, as shown in the illustration, to stop the table before it gets to a point where overhang will cause it to tip off the rolls. This safety device was suggested by the machinist shown operating the openside planer.

Removing Key on Wheel-Press Beam

The adjustable resistance beam on some types of hydraulic driving-wheel presses is established as to location by the insertion of a key through the upper end jaws of the beam and the top rail of the press. This key must, of necessity, be removed when the position of the vertical beam is changed. Because of the height of the press it is a rather inconvenient job to remove and replace the key and at the same time make the necessary



This shows the application of the device on the resistance beam of the press



Details of the parts required for the key removing device

change in the position of the beam. The wheel shop foreman in one shop solved this problem by a key-removing device, the application of which is shown in the photograph and the details in the accompanying drawing. The device is merely a handle, which may be operated from the floor, with a bracket secured to the beam casting for the purpose of providing a rest for the key when it is in the "out" position. By the use of this device, it is a comparatively simple matter to line up the key slots in the beam and the top rail and replace the key without the necessity of climbing up on the machine.

Safety Suggestions

"Safety Suggestions" is the title of a poster which has recently been developed by the St. Louis-San Francisco for display about the shops. The poster is a tracing from which 11-in. by 17-in. blue prints are made. It contains twelve specific suggestions, all of which are summarized in the "A-B-C's for Safety: Arrive on job with a clear head; be mindful of safety rules; concentrate on the task at hand." The following are the twelve suggestions:

1—I shall get my proper rest.

2—I shall wear my goggles at slightest need, and call it to attention of my fellow workman if he neglects to do so. I must wear my goggles while performing the following jobs: babbiting, burning, caulking (all work), grinding on emery wheels, chipping (all work), drilling (overhead), flue boring, lathes (brass), riveting, scaling boilers, handling acids and Oakite, sandblasting flues, spray painting, welding.

3—I shall never wear loose or baggy clothing around revolving power machinery.

4—I shall never work with defective tools and will return them to the toolroom or report them to foreman.

5—I shall never attempt to operate a machine unless instructed by foreman or some qualified instructor.

6—I shall always wear safety shoes and keep them properly repaired.

7—I shall always endeavor to protect my fellow workman from personal injury, as well as myself. So, I shall not drop tools or materials without knowing it is safe to do so.

8—I shall keep premises, on which I am working, as free of obstructions as possible.

9—I shall not operate brake on engines, cars or tender, without notifying employees working underneath.

10—I shall not insert fingers to determine if holes are in proper alignment, for the insertion of bolts, pins and rivets.

11—I shall use approved respirator, if necessary, when spray painting.

12—I shall report any unsafe condition to my foreman, and do my work in the safest possible manner, remembering that the safe way is the right way and the right way is the safe way.

Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on problems relating to welding practices as applied to locomotive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity will not be disclosed when request is made to that effect.)

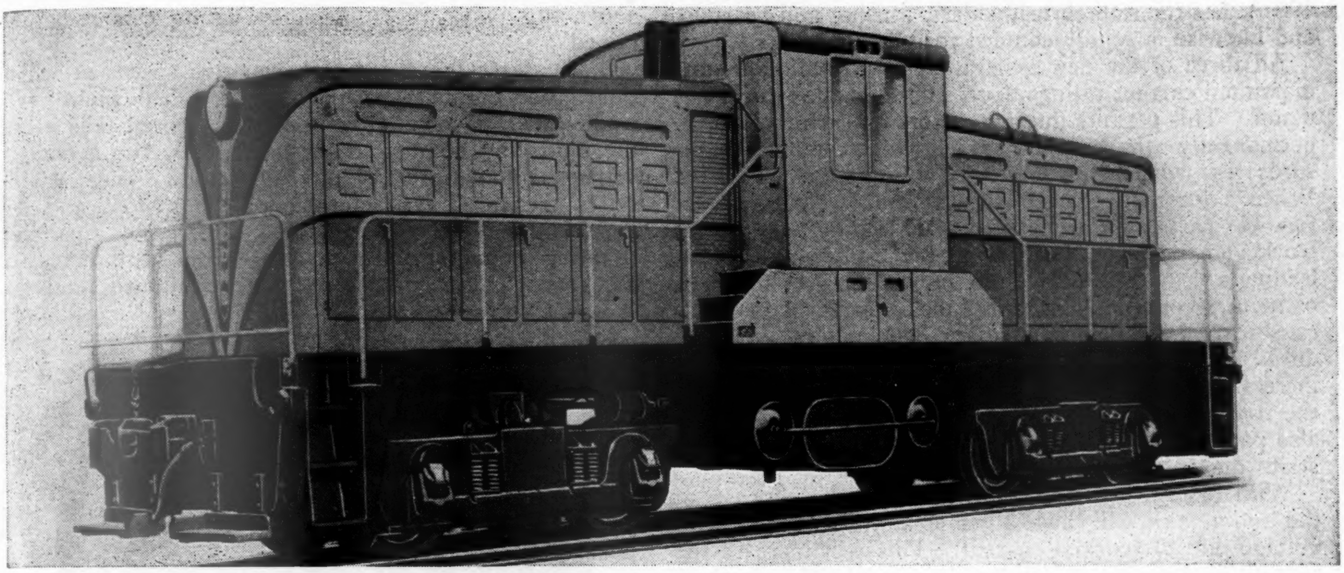
Combatting Warping In Welding Thin Plates

Q.—When welding thin plates we have encountered difficulty in preventing warping. Can you indicate what we are doing that is wrong and suggest a remedy?

A.—Warping is a form of distortion which can result from shrinkage in welds, excessive local heating, poor joint preparation or improper clamping of parts in position for welding. Some of the things which you might try are the selection of an electrode which has moderate penetrating qualities and which can be handled at high speed—a welding speed sufficiently fast that it prevents local overheating—and a step-back welding sequence. Proper clamping without permitting excessive spacing between the sheets should also help. The use of a back-up to distribute welding heat and cool the parts rapidly is especially useful on thin sheets. Peening the joint edges slightly before welding elongates the edges and, when the weld shrinkage occurs, they tend to pull back to their original shape.

Courtesy Westinghouse Electric & Mfg. Co.

Controlled procedures result in a weld as shown on the right



A typical 80-ton Diesel-electric locomotive with double power plant

Electrical Equipment

For 65- and 80-Ton Switchers

By S. E. Newhouse*

In spite of the necessity for manufacturing the electrical equipment as quickly as possible, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., after a careful analysis of the probable future requirements, embarked on a program of developing a new traction motor and new generators for the various Diesel engines applied on 65- and 80-ton locomotives. This development was carried on in parallel with the manufacture of the former standard equipment, and the changeover to the new standard equipment was made without delay.

The new motor is known as type 970-A. It is a series motor suitable for either the 65-ton or 80-ton locomotive. It is self-ventilated, but may be force-ventilated whenever the service requirements dictate a high continuous tractive force rating. It is supported on one side directly on the axle by bronze axle bearings and on the other side by a nose suspension on the truck transom. It has roller armature bearings and high-temperature glass-weave mica and asbestos insulation. Four of these motors are geared 14 to 72 on 36-in. wheels on the 80-ton locomotive. This provides a maximum safe speed of 40 m. p. h. which is ample for transfer service and some road freight haulage. On the 65-ton locomotive this same gear ratio may be applied, or a 17 to 70 gear ratio on 36-in. wheels may be used, providing 50 m. p. h. maximum safe speed which may be desirable if the locomotive is used in road service. Due to limitations in maximum adhesion, a 65-ton locomotive cannot develop as high a maximum tractive force as an 80-ton locomotive, and consequently there is no objection to the reduction in tractive force with the latter gear ratio on the lighter locomotive.

The new generators are of the shunt type. This simplifies the control circuits and eliminates the separate exciter required with the differential system used on some of the former equipments. In addition to the self-excited shunt field, the generators have a small battery-excited field to assure prompt response of generator voltage in accelerating the locomotive and a series winding for use in engine starting from battery power. They have a high-temperature glass-weave mica and asbestos insulation. Each generator has a single anti-friction bearing supporting the armature at the commutator end and is self-ventilated by a fan located at the end adjacent to the engine.

All of the newer 65- and 80-ton locomotives have double power plants using engines which are in quantity production. A high-speed engine commonly applied on 65-ton locomotives rates 200 hp. at 1,800 r. p. m. The type 193-PC generator is used with this engine. It is connected to the engine through a flexible coupling.

A slower-speed engine suitable for either weight locomotive is rated 250 hp. at 1,200 r. p. m. and another engine, often applied, is rated 250 hp. at 1,000 r. p. m. This type 196-A generator has been developed for application with either of these two engines. It is solidly coupled to its engine.

A higher-rating engine, generally used on 80-ton locomotives but applied on the 65-ton size when high power is required (as for road service), is rated 325 hp. at 1,200 r. p. m. The type 197-A generator is suitable for this engine. It is similar in construction to the type

---

* Transportation application engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

196-A, has the same brushholders, brushes and bearings, and likewise is solidly coupled to its engine.

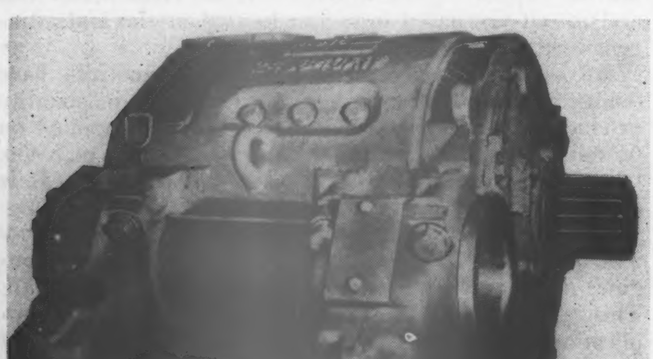
All three of the new generators have continuous and maximum current ratings double those of the type 970-A motor. This permits the two motors on each truck to be permanently connected in parallel, which combination assures less wheel slippage than with motors in series. When a locomotive is starting a train, weight transfer removes part of the weight from the leading axle of each truck and increases the load on the trailing axle. The leading axles are therefore the first to slip. With a pair of motors connected in series, the slippage of one axle causes a reduction in current for both motors. The reduced generator current results in higher voltage and increases wheel slippage. The locomotive not only loses the tractive force of the motor on the slipping axle but also part of the tractive force of the motor connected in series due to the reduced current.

With motors permanently in parallel, the slippage of the leading axle will cause a momentary rise in generator voltage due to reduced current. This will increase the current in the motor on the trailing axle. This increase in load prevents a further increase in generator voltage. While the tractive force of the slipping axle is lost, the tractive force of the trailing axle is increased. It will have little tendency to slip because additional weight has been transferred to it. Part of the generator power output is transferred from the slipping axle to the trailing axle, thus permitting the acceleration of some trains that could not be started with motors in series.

Control

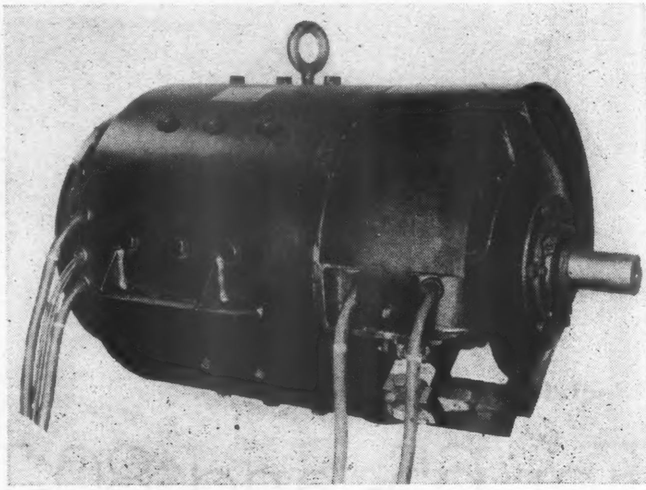
The locomotive speed and the direction of motion are controlled by the manually-operated engine throttle and master controller through the remote operation of switching devices and relays mounted in the control cabinets. The relays and control contactors are operated by electro-magnets while the reverser in the traction-motor circuits is operated by electro-pneumatic valves utilizing compressed air.

At starting, the motors are operated with full field strength. Opening the throttle increases the engine speed. This increases the generated voltage applied to the traction motors and accelerates the locomotive. As the locomotive speed increases, the generator current decreases and its voltage increases proportionately, thus utilizing the full engine output. Finally a point is reached beyond which the generator voltage increase is far less than in proportion to the reduction in current. This is called the unloading point. At currents below, and speeds above this point, the full engine output cannot be obtained.

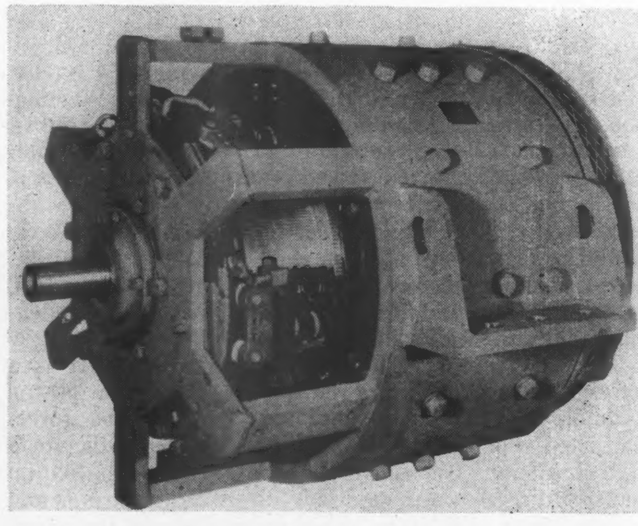


The type 970-A traction motor

To increase the range of locomotive speeds at which full engine output is available, motor field shunting is employed. As soon as the generator current falls below the unloading point, a relay actuated by the generator voltage automatically shunts the motor fields. This raises the speed characteristic of the motors and decreases the torque per ampere. Hence, by this field shunting the motor and generator currents are increased, the speed and tractive force are maintained, and the generator continues to utilize the full engine output as the train speeds up until the current again decreases to the unloading point. The use of full field strength in starting provides the maximum tractive force most economically while the shunted field affords a means of using full engine power to a higher speed than is possible with full field on the motors.



The type 193-PC generator



The type 197-A generator with commutator covers removed

The preferred system for battery charging includes two 1¾-kw., belt-driven auxiliary generators suitable for charging a 32-volt battery. These generators are regulated for constant voltage for all engine speeds from idling to maximum operating speed. The lighting and control circuits are energized from the storage battery.

On the locomotives with type 193-PC generators, a single 32-volt battery is required. This generator is

capable of starting the 1,800-r. p. m. engine from a 32-volt battery of suitable capacity. Due to the much more severe starting requirements of the larger, slower-speed engines, two 32-volt batteries are used on locomotives with types 196-A and 197-A generators. The two batteries are normally connected in parallel but when starting the engines, 64 volts are obtained by connecting the batteries in series. With this arrangement the batteries will be charged even during an emergency when one engine is not operating.

The 65-ton locomotive's continuous tractive force with self-ventilated type 970-A motors geared 17 to 70 on 36-in. wheels is 9,000 lb. With 1,000 cu. ft. of air per minute force-ventilation for each motor, the continuous tractive force is increased to 18,500 lb. When these motors are geared 14 to 72 on 36-in. wheels on either locomotive, the self-ventilated continuous tractive force is 11,300 lb. and, when force-ventilated with the previously mentioned amount of air the continuous tractive force is 23,200 lb.

The type 197-A generator has a higher continuous current rating than the other two generators. When necessary to use its full capacity for especially heavy duty, the motor force-ventilation is increased to 1,400 cu. ft. per minute and the locomotive's continuous rating becomes 26,000 lb. tractive force, corresponding to 16.2 per cent adhesion on an 80-ton locomotive.

Experience indicates that a continuous tractive force corresponding to 14 per cent adhesion is ample for the great majority of severe services. These 65- and 80-ton locomotives with force-ventilated motors equal or exceed this adhesion value. It is an established fact that, for any given insulation, low mean operating temperature of the electrical equipment promotes long life of the insulation. The high continuous rating of these locomotives assure reasonable operating temperatures and, therefore, long life of their generators and motors even in very heavy service.

Army Hospital Train Is All-Fluorescent Lighted

A new hospital train for the United States Army Medical Corps, to be used first for training purposes in Southern California and then for service abroad, has been completed and is now being shown in a dozen principal cities across the country. The cars were built by the Pullman-Standard Car Company, and a feature of their equipment is the all-fluorescent lighting which was supplied by Sylvania Electric Products, Inc., Salem, Mass.

Specifications for lighting equipment include vibration-proof fixtures of the trougher type which can be recessed into the ceiling. Steel was allowed for their construction. Before installation, engineers submitted the fixture—complete with lamp, reflector, starter, ballast, sockets and wiring—to vibration in a machine which subjected them to 1,000 vibrations per minute, with a variable range of amplitude up to one-half inch.

The equipment on the ten-car train includes 59 40-watt, single-lamp troughers; 12 15-watt, single-lamp troughers; 18 6-watt, single-lamp wall fixtures; 10 15-watt wall-lamp brackets, and eight 15-watt desk lamps.

Fluorescent lamps were selected for the train because they will add little heat to the cars in hot climates, because they do not project into the car, allowing more head room, and to provide surgeons with light without undesirable shadows in the operating area. A utilities car, containing two steam boilers and two steam-driven generators, supplies heat and power for the train. Two cars are for the staff of five medical officers, seven nurses and 33 enlisted men. Six are ward cars with 16 berths for bed patients, plus the operating spaces, toilets and shower rooms, and the tenth car is the kitchen-diner-pharmacy.

Interior of one of the ward cars in the Army Medical Corps' new ten-car hospital unit

Lead-Coated Steel Banding Wire

That use of "alternate" materials does not necessarily mean impairment of quality is shown by the way in which lead-coated steel is doing a better job than did copper or brass in the manufacture of a small part for electric motors. Such steel was adopted by engineers of the Fort Wayne, Ind., works of the General Electric Company in order to conserve critical metals previously used for making banding rings. Rotors of certain types of motors were previously equipped with such banding rings of either copper or brass, solely so that the rotor could be dynamically balanced by applying drops of solder to the band as required. Solder would adhere easily and tightly to either of these metals.

Solder likewise clings tightly to lead, so by changing to bands made from lead-coated steel, several thousand pounds of copper and brass have been conserved. In addition, because of the greater tensile strength of the steel, the weight of the band has been reduced by nearly 60 per cent since a thinner band can be used. Still another advantage resulted since the thinner steel band leaves a greater radial space available for the balancing solder.

Vulcanizing Portable Cable

The Illinois Central has for some time made a practice of vulcanizing breaks and splices in portable rubber-covered electric cable. The work is done at seven different points on the railroad and has resulted in greatly extending the life of all such cable, reducing shock hazard and

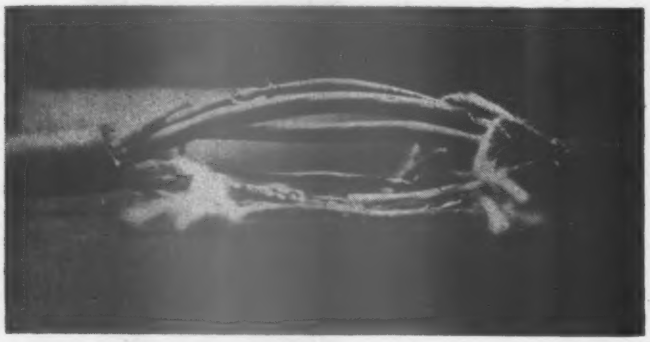


Fig. 1—A six-conductor cable with electrical connections made ready for insulating

short circuits caused by defective or worn taped joints. The procedure has of course also saved a large amount of rubber which would otherwise have been required for cable replacements.

Vulcanizers and molds are available for all sizes of cable. The Illinois Central does not make a practice

Fig. 2—The cable shown in Fig. 1 made ready for vulcanizing with a wrapping of rubber tape

of vulcanizing lamp cord, but does repair and splice all larger sizes of portable cable. This includes the a. c. cables for welders, the welding cables and all cables for portable tools.

Fig. 3—The finished vulcanized joint—It is slightly stiffer than the rest of the cable but will stand almost as much flexing and effectively protects the cable from moisture

The procedure for making a splice is illustrated in Figs. 1, 2, and 3. The several conductors are first connected and soldered as shown in Fig. 1, care being taken to stagger the connections so that no two are opposite each other. Then special insulating rubber splicing compound is wound around each splice to a diameter slightly greater than the original insulation.

The conductors are then placed in proper relation to each other, and with multiple cables such as the one

Fig. 4—The vulcanizer in use—The operator is tightening the mold clamp and the cable being repaired may be seen under the operator's arm and extending from the right end of the vulcanizer

shown, the grouped assembly is, if necessary, filled out with strips of rubber or other suitable filler to make the group round. Vulcanizing rubber tape is then wound over the splice as shown in Fig. 2 to a diameter slightly larger than that of the mold in which it is to be vulcanized.

The final operation consists of placing the taped joint in a mold of the right size, applying pressure to the mold and then bringing to vulcanizing temperature. Close

Fig. 5—Worn and restored Spicer torque-arm bushings—The cut in the restored bushing was made solely for the purpose of showing the excellent quality of bond between the old and new material—The inner diameter wears very little and it is not necessary to remove a section to restore the inner fit

control of temperature is important. The finished joint as removed from the mold is shown in Fig. 3.

One of the vulcanizers, made by Mines Equipment

Company, St. Louis, Mo. is shown in operation in Fig. 4. It consists of an electrically-heated steam chamber which is channel shaped, allowing space for the two-part molds which are squeezed onto the cable splice by means of screw clamps. The steam used to surround and heat the vulcanizing space is generated electrically and the current is automatically cut off when the required pressure (and temperature) is reached. A drop in pressure restores the current. The control is sensitive and will hold the temperature within a few degrees.

Another use of the vulcanizer has been developed by the electrical maintainers of the Cincinnati Union Terminal Company. In addition to its use as a cable vulcanizer, it has been applied to the restoration of mechanical rubber. These include such items as Spicer torque-arm bushings and the shear rings known as mechanical fuses in the General Electric axle-generator drives. Special molds having a contour conforming to the full-size parts were made by the terminal forces. The worn parts are built up to a little oversize with vulcanizing tape, compressed in the molds and vulcanized. The clamps are further tightened during the heating process. One special mold made in the terminal is Y-shaped and is used to connect two battery charging cables in parallel when heavy current carrying capacity is required.

Silver Solder Dispenser Avoids Waste

An easy-to-make dispenser suggested by John Antkowick, a workman at the General Electric's Schenectady, N. Y., works, simplifies the feeding of ribbon-type solder in silver-alloy brazing work and prevents waste. The dispenser is a flat metal case containing two rollers, one in the circular portion and another near the point. The

Silver-solder dispenser in use for resistance-brazing of coil terminals

silver solder is thumb-fed over the second roller and out the point of the dispenser through a slot in the edge of the case. Previously, the operator would cut a piece of solder about two feet long. As this strip became shorter it would get too hot to handle and the workman would drop it and get another piece. The dispenser can be loaded quickly with sufficient solder for a large number of brazes, and permits the operator to keep his hand far enough from the work to avoid being burned.

Floating Rides For Trains

Servo-mechanism principles that enable American tanks to fire accurately while running over rough ground quite possibly will provide "floating" rides in high-speed trains and other vehicles, according to engineers of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Actual development work on these applications has been started. Calculations show that the power required to stabilize the vertical movement of a railroad coach is only about three horsepower. The mechanism necessary to accomplish this is small enough to fit into an over-night bag. Curiously enough the servo-mechanism to stabilize a railroad car will require about the same size as that required for an automobile. The reason for this is that the equipment required depends on the weight of the object multiplied by the square of the up and down movement of the road. The automobile is much lighter, but the vertical movement is several times that of a railroad car.

Electrolytic Filter Cleaning

The Missouri Pacific employs a cage-type filter in the fuel oil lines of its Diesel-electric locomotives. The filter has a circular flat edge-wound element having openings of .003 to .006 in. between coils and is very effective in removing solid material from the oil; but after protracted service the metal of the filter element becomes coated with a deposit of dirt and carbon which stubbornly resists any of the usual methods of chemical or mechanical cleaning.

A novel method of electrolytic cleaning was evolved in principle by K. E. Lane, chief chemist, and worked into a shop facility for use on the filter by the electrician at the railroad's Diesel shops at St. Louis, Mo.

The process consists of placing the filter element in a solution of caustic soda with a sheet of iron about ten inches square. The iron sheet is connected to the positive terminal of a small motor-generator set and the filter element is connected to the negative. A current of about 25 amperes is run through the bath for about 15 minutes; this requires from 22 to 24 volts.

Since the filter element acts as the cathode, a large amount of hydrogen is evolved from the metal surface of the filter plates and this effectively lifts the dirt deposit off the plates so that it is easily removed afterward by rinsing with running water.

The current should not be reversed since this would tend to remove the surface metal from the filter plates. When used as described, no measurable amount of metal is plated onto the filter plates, since plating requires that the surface of a metal be carefully prepared. The method does not work well on all types of filters, but it suggests some interesting possibilities for shop cleaning of various things such as air-conditioning evaporators and condensers and other things having shapes which make mechanical cleaning difficult.

A "WACKY" SITUATION

by Walt Wyre

ONE electrician was off sick and the one and only electrician helper for the S. P. & W. at Plainville had been called into the service. Ned Sparks and the other remaining electrician on days were working ten to sixteen hours and getting about as far behind on work as they were on sleep.

Jim Evans, the roundhouse foreman, had little to offer except sympathy. He was short of help, too, and couldn't spare any. Then, for some more of the same served in a slightly different manner, the division engineer decided to replace the worn out oil engine at one of the wells in Middleton with an electric motor and make the treating plant operation automatic except for mixing the chemicals, all of which was to be done because of labor shortage.

Ned Sparks was repairing a portable grinder motor when the clerk brought the traingram about the work to be done at Middleton. Material for the pole line was already on the way. Secondhand wire from an abandoned line at some other point was to be used. The motor would be along in about a week along with conduit, wire, etc., for the rest of the job. Sparks read the traingram and headed for the roundhouse office.

"Yeah, I know you need some help," Evans greeted Sparks. "Well, so do I, but can't get it. I was expecting you when I saw that traingram about the job at Middleton."

"How in the heck can I build a pole line without help?" Sparks sputtered. "I might stagger along doing the inside work by myself, but building a line takes at least two men."

"Well, you might talk to the master mechanic about it," Evans said. "Maybe he can find you a helper, I can't."

"Just what is an electrician helper supposed to do?" H. H. Carter, the master mechanic, asked when Sparks had told his story.

"Oh, bring material, tie tools and wires on a handline—just help electricians," Sparks replied somewhat vaguely.

"The work is not particularly heavy," the master mechanic commented, "your tools are not very heavy."

"No, most of the tools we use are fairly light, sometimes we have to handle some pretty heavy rolls of wire."

"O. K.," Carter said, "I'll send you a helper tomorrow morning. We had an application about two hours ago. When are you planning to go to Middleton?"

"Day after tomorrow, I guess,"—Sparks scratched his head to stimulate the process of thinking. "There are several small jobs here that should be done. They'll take another day, then I'll want to ship the line tools to Middleton."

As he left the office, Sparks stopped at the chief clerk's desk and asked him to wire the agent at Middleton to reserve a room for an electrician and helper.

NEXT morning at about ten minutes before eight, Sparks went into the electric shop. He noticed someone wearing blue coveralls and a shop cap to match sitting at the make-shift desk in the corner. He supposed it was the new helper. Sparks rushed to his locker with only a slight glance towards the helper.

"You look pretty small for an electrician helper," Sparks said as he pulled his shirt off. Then he started to remove his trousers. "How old are you?"

"It's none of your business!" a distinctly feminine voice replied. Sparks hastily pulled his pants up and turned around. "Are you in the habit of undressing in the presence of strange girls?" she asked.

"Girls, strange or otherwise, shouldn't come into the electric shop just before eight o'clock," Sparks managed to say. "If you'll just step outside a moment until I change clothes, you may come back and sit at the desk until five o'clock this afternoon. I'll want to change clothes again then."

The girl took eight steps and three seconds getting outside, but in that time Sparks noted that the camouflage of coveralls and cap didn't entirely conceal well placed curves and hair the color of new copper.

"O. K.," Sparks said loudly. "You may come back and sit."

"Is that what an electrician helper is supposed to do?"

"What!" Sparks yelled so loudly the girl jumped. "You the new helper?"

"That's right, and I'm not deaf. My name is Dell Malone. I suppose you are Ned Sparks. Call me Red if you like, I'm used to it."

"Glad to meet you, Red. Bet you would be awful nice to dance with, but can't hardly imagine you helping me on a pole line.'" Sparks managed to smile but it was rather feeble. "Know anything about electricians' work?"

"Some; my brother works for the power company. If you like, I'll start by sweeping the floor."

"That's a good idea," Sparks said. "I'm going to ship some tools to Middleton for a job there."

"Tell me where they are. I'll get them," Dell suggested. "What will you need—pike poles and digging tools?"

"That's right, you do know something, but they are too heavy for you. I'll get them while you sweep the floor."

"We might as well have an understanding now. I'm supposed to be your helper and do helper's work. There may be times when some of it will be too heavy, but I'll let you know. If you had a man for a helper, he would carry the tools. That right?"

"Yes, but——"

"O. K.," Dell smiled, "where are the tools and where do I take them?"

"They are on a rack back of the electric shop." Sparks, being married, knew that the only way to end an argument with a woman is to agree with her. "Take them to the storeroom and tell the man at the counter to ship the tools to me at Middleton."

Dell left the electric shop and in a few moments Sparks heard a scraping noise. He looked out the window and saw the girl dragging the digging tools on the sidewalk going towards the storeroom. In less time than he expected, she was back at the electric shop asking what to do next.

"Oh, by the way, I almost forgot. Did they tell you at we were planning to go to Middleton tomorrow? . . Oh, good Lord!" Sparks suddenly exclaimed.

"Yes, I was figuring on going. What's the rush?" Dell asked the question because Sparks was leaving e electric shop in a heck of a hurry.

He rushed to the master mechanic's office and to the hief clerk. "Did you wire the agent at Middleton to eserve *a* room for an electrician and helper?"

"Yes," the clerk replied, "but I don't see any reason o get excited about it."

"Well, wire him to reserve two rooms for a male elecrician and a female helper. They've given me a lady elper!"

"Looks to me like the lady should be doing the comlaining," the clerk said as he reached for a pad of clip o write the message.

WHEN Sparks returned to the electric shop he found hat Dell had swept the floor and was busy putting things n order. When he entered she stopped and surveyed he room critically.

"If you are thinking what I think you are thinking, tart thinking about something else." Sparks smiled o show he didn't intend to be as hard-boiled as he ounded.

"What do you think I was thinking?"

"When a woman has that look in her eyes, she's planning to start moving things around. I haven't been married twenty years without learning that much."

"Well, the shop would look better if the desk was ver in the other corner, but I won't mention it if you re going to be cranky about it."

"O. K., I'm cranky," Sparks agreed. "Now that hat's settled, there's an electric welder in the machine hop that has a grounded generator. I'll bring it to he electric shop and we'll repair it."

Sparks' more or less diplomatic attempt to keep his redheaded helper from going to the machine shop with him didn't work; she went right along. Every man in the shop looked and a few whistled, and Sparks felt like he imagined a sideshow freak must feel as they walked across the shop. He pulling, she pushing, they wheeled the welder into the electric shop.

"Go to the storeroom and get a gallon of solvent and half a gallon of tetrachloride," Sparks told her.

"A gallon of what and half a gallon which?" Dell asked.

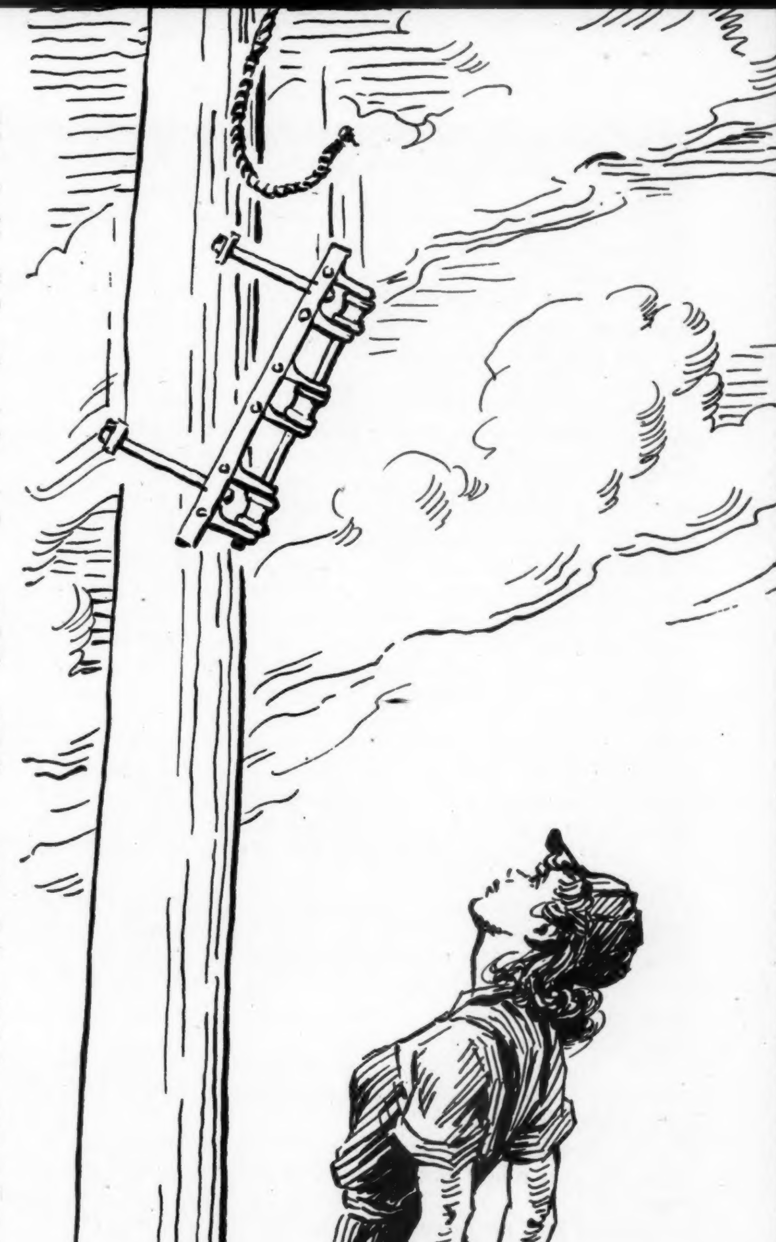
"Solvent and tetrachloride—here, I'll write it down for you." Sparks wrote "solvent" then "tet"—and stopped. "Tetrachloride, surely you can remember that! Tell the man in the storeroom it's for cleaning a motor; he'll know." Sparks crumpled the piece of paper on which he had been writing and threw it in the trash can.

While his helper was gone, Sparks lifted all of the brushes of the welder generator and tested the armature for a ground. It showed clear. He then tested the fields and found the ground to be in the series field winding.

By the time that was done, Red returned with the cleaning solutions. He explained how he wanted all of the various bolts and nuts washed with solvent and laid out in order to facilitate replacement. When the bearing, end bell, and brush holder frame was removed, he told Dell to use solvent first then a little tetrachloride to remove the solvent from the brush holder frame. "Tetrachloride dries quickly," he explained.

"So I see and it does a good job of removing nail polish, too," Dell remarked.

Repairing the field coil didn't require much time. Vibration had worn through the insulation on one corner



Headache!

of the pole piece, Sparks removed the tape and broken insulation, replaced it with some new and retaped the coil.

Dell watched with evident interest and remarked, "Huh, all that work for such a little job! What can I do to help?"

"Don't be impatient," Sparks told her. "You can get that can of red insulating lacquer from the locker at the end of the bench. You'll find a brush too, and paint all the field coils."

"Ah!—nearly a gallon of nail polish," Dell exclaimed as she poured some of the red liquid into a small can. "Isn't there something else messy you can think of?"

"Not unless you call grease messy. We will repack all of the ball bearings with it," Sparks said.

Next morning Sparks and his new helper went to Middleton. The train was about an hour and a half late and it was nearly two o'clock in the afternoon when they arrived. Sparks was hungry as a hibernating bear in springtime, but he took time to call the hotel and find out if they had two rooms reserved. He was greatly relieved to find out that they had.

AFTER lunch they changed into working clothes. Dell used the ladies' rest room at the passenger station while Sparks changed in the treating plant. Sparks wanted to do a little figuring and planning on the treating plant. He decided to get rid of Dell and play a little joke on her at the same time.

He laid out the pole line to the well, driving a stake where each pole was to be set. "Now," he said, "while I'm working at the treating plant, you go to the freight house and get the digging tools. Dig a hole five and a half feet deep where each one of those stakes are. Know anything about digging holes?"

"No, not much," Dell said hesitatingly. "I've seen the men from the power company digging and it looked like awful hard work."

"Well, that's a helper's job. Being a little green at the job, you might not get all five holes dug this afternoon."

Sparks had no intention of letting the girl dig at all, but he got busy at the treating plant and time passed more quickly than he thought. It was almost an hour before he left the treating plant. His conscience bothered him when he realized how long it had been and his remorse was greater when he saw Dell trying to dig a hole. She was using the long handled spade like a person digging a Victory garden, but she couldn't get enough weight on her foot to sink the heavy spade. The long handle towering like a flagpole over her shoulder almost threw her off balance when she tried to dig. Her eyes were almost leaking tears when Sparks came up. She didn't say anything, but she gave him an awful swearish look.

"Here, let me show you how to use a spade," Sparks said.

"Let me alone!" Dell snapped. "I'll dig this hole if it takes all week."

"Well, you don't mind if I show you how, do you? Sit down over there and I'll give you a few pointers." Sparks took the spade and started to dig, but couldn't locate the center of the hole because the stake was gone and the ground was scarred in a place about three feet square. Sparks sighted down the line and located where the hole should be and drove another stake. He then looked at his watch and noticed it was 3:35. "We won't have time to dig any more this afternoon. Let's go over to the treating plant and get started there. I'll see if we can't get a couple of section hands to dig the holes tomorrow morning."

"I thought you were going to show me how," Dell protested.

"Oh, I was joking. It took me longer at the treating plant than I figured."

Dell did a fair job of cutting and threading half-inch conduit. She sawed some of it rather crooked and broke a couple of blades until she learned to take long, even strokes with light pressure on the saw. Sparks put a longer handle in the die ratchet so it would operate with less power.

All of the conduit was run and wires pulled in at the treating plant by noon next day. Then when Sparks started to solder the connections he found that he had forgotten to bring a blow torch. He tried using matches to heat the wire as he had done many times before when the wire was small, but he hadn't been using war-time solder before. He burned his fingers and smoked the wire, but the solder wouldn't flow. He tried everywhere to find a blow torch, but there was none to be had. While searching in a tool shed he happened to notice some fusees and decided maybe they could be used. He first tried to solder the connections by heating the wire but that didn't work. Then he tried heating a soldering iron with a fusee. The iron got hot but sulphur from the fusee coated the tip until he learned to direct the sulphurous flame so it wouldn't strike the tip of the iron. Then it heated the iron without fouling the tip and he got the job done.

By the time the job at the treating plant was finished the section men had almost finished digging the holes. "We will get a push car and bring all of the line material from the freight house while they are finishing the holes," Sparks said. "Then, while I'm helping the section gang to set the poles you can distribute the material."

BY THE time Sparks had finished outlining the work they had reached the freight house where the material for the line was stored. There were several boxes, some bundles of racks and a pile of wire that looked like leavings from a scrap drive. The wire, number two stranded weatherproof, was in pieces some less than seventy-five feet long. "Good Lord!" Sparks exclaimed, "it'll take a whole day just splicing and taping."

They loaded the material on the push car, then shoved it up the main line to the lead that ran parallel and close to the line to the well. Dell thought it was fun sitting on the push car and shoving it along, but she wasn't doing much pushing because she could barely reach the cross ties with the toe of her foot.

"We will just scatter these rolls of wire along the line. After you finish placing a rack, three insulators and two bolts at each pole you can start unrolling the wire and stringing it out on the ground. Don't try to handle the larger rolls, they are too heavy."

The poles were all set and tamped by quitting time and the wire laid out ready for splicing.

The poles were already bored for the bolts to hold the racks and it didn't take long to fasten them in place. Dell came very near getting her head cracked when a rack she had tied on the hand line came loose. Sparks yelled "headache" from habit, but it meant nothing to the girl, who stood there until the rack hit the ground.

"Wow! That was close!" Sparks said. "Sure glad it missed you and it would have been my fault if it had hit you. I should have told you to always step back out of the way when anything is being pulled up on a hand line."

"Well, I'll try to remember and tie things so they

(*Continued on next left-hand page*)

A.M.C.C.W. PLANTS

ARE STRATEGICALLY LOCATED—

to better serve ALL Railroads

1 Albany Car Wheel Co.
2 American Car & Foundry Co.
3 Canada Iron Foundries, Ltd.
4 Canadian Car & Foundry Co.
5 Cleveland Production Co.
6 Dominion Wheel & Foundries, Ltd.
7 Griffin Wheel Company
8 Louisville Car Wheel & Railway Supply Company
9 Marshall Car Wheel & Foundry Co.
10 Maryland Car Wheel Co.
11 Mt. Vernon Car Mfg. Co.
12 New York Car Wheel Co.
13 Pullman-Standard Car Mfg. Co.
14 Ramapo Foundry & Wheel Works
15 Reading Car Wheel Co.
16 Southern Wheel Division of the American Brake Shoe Company
17 Tredegar Iron Works

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE, NEW YORK, N. Y. • 445 N. SACRAMENTO BLVD., CHICAGO, ILL.

ORGANIZED TO ACHIEVE:

UNIFORM SPECIFICATIONS • UNIFORM INSPECTION • UNIFORM PRODUCT

3493

won't come loose," Dell said, trying to keep from showing that she was still scared.

"Now for a job of splicing," Sparks said as he started removing his climbers.

"What am I supposed to do?" Dell asked.

"When I finish making the splice, I'll show you how to wrap it with tape," Sparks told her.

"I believe I could do that," Dell remarked when the first splice was finished and ready for taping.

"Anyway you are ready to try," Sparks said as he picked up a roll of weatherproof tape. The electrician finished taping the splice and started to walk over to the other end of the piece of wire when a water service helper came up.

"The pump motor at Wheeler won't start. The dispatcher said for me to take you out there in our car right away," the water service man told Sparks.

Sparks picked up some tools, then turned to Dell and said, "It's only twelve miles to Wheeler. We should be back in about an hour and a half. You can skin insulation off the ends of the wires and have them ready to splice when I get back. Don't cut your finger."

He handed her the skinning knife and left.

THE job at Wheeler took longer than Sparks had figured. The trouble was a wire burned through inside the motor. After Sparks decided the trouble was in the motor winding, it was necessary to take the motor apart, splice the wire, and reassemble the motor. It was nearly eight o'clock when Sparks returned. He didn't see anything of his redheaded helper until they met at breakfast next morning.

"How did you make out after I left?" Sparks inquired. "Didn't cut your finger, did you?"

"No, but I got gooey all over my hands."

It was too early in the morning for Sparks' wits to be working well or else he would have noticed a smirk in the girl's smile and remembered that the insulation on the old wire they were using wasn't "gooey."

"Well, I'll start splicing wires," Sparks remarked resignedly when they reached the job. He walked over to where the wires lay stretched out.

"Say, I didn't make but one splice!" he exclaimed. As far as he could see to tell, all wires were spliced and taped. "I told you not to splice the wires," Sparks said. "Now I guess I'll have to take them apart and make new joints."

"Those will hold all right," Dell said. "Why don't you take the tape off one and look at it?"

Sparks had the same idea. He removed the tape from one of the splices. "Where did you get solderless connectors?" he asked.

"In one of the boxes that we brought over from the freight house. I noticed them when we were loading the stuff on the push car. I called the power company and asked them to send a man down here. He showed me how to put them on. Are they O. K.?"

"You bet!" Sparks replied. "Now we can finish today as we figured. It was pretty smart of the electrical engineer to send them and you are not so dumb yourself."

That night riding on the train to Plainville, Dell said to Sparks, "How do you like having a girl for a helper?"

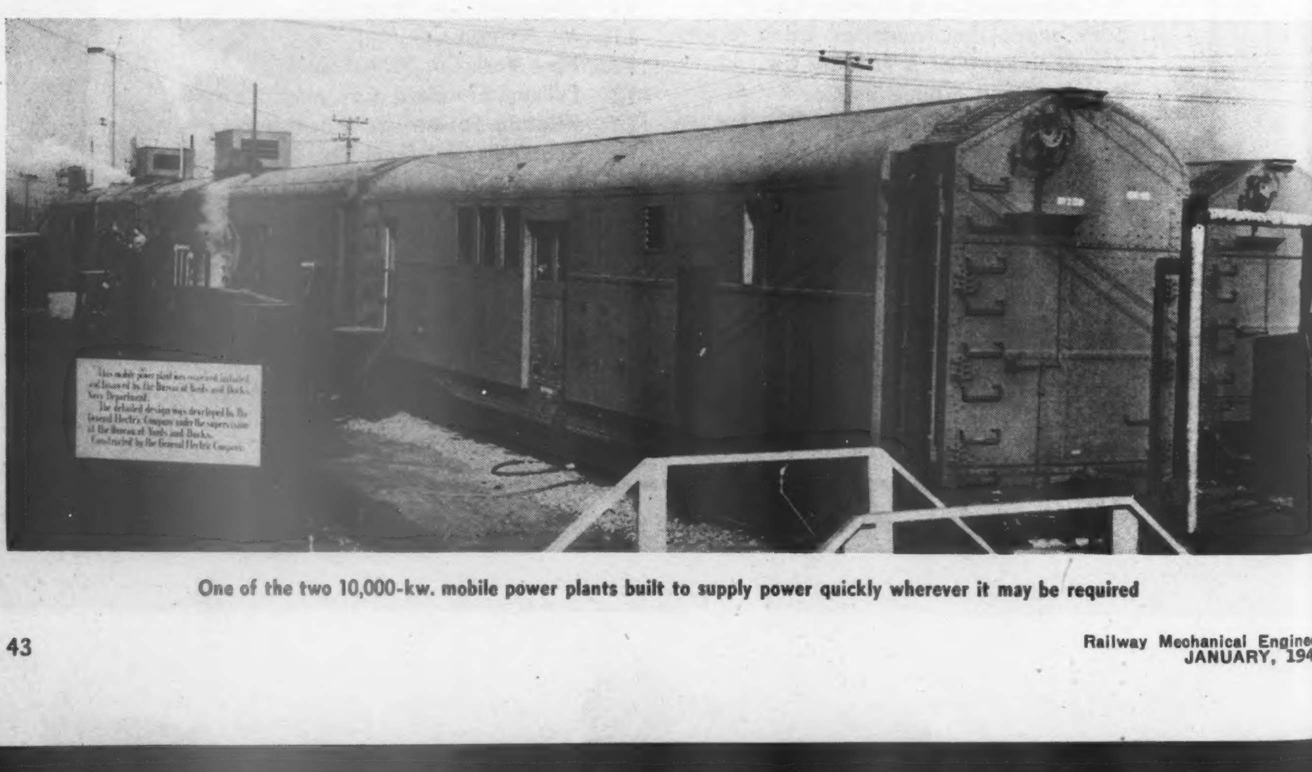
"Well," Sparks replied grinning, "right now there's not much choice, but between a dumb man and a smart girl, guess I'll take the girl."

Mobile Power Plants

Two mobile power plants, each consisting of a three-car unit comprising a complete 10,000-kw., steam-electric generating station, have been built for the Navy by the General Electric Company, Schenectady, N. Y. The plants were conceived, initiated, and financed by the Bureau of Yards and Docks, U. S. Navy Department. Although the units in themselves are unique, the apparatus involved is of the same type proved in service in regular central station and industrial power plant installations throughout the country. The units can be hauled over the rails at speeds up to 40 m.p.h.

General Electric engineers estimate that the mobile power plants can be "put on the line" within 24 hours after they are shunted into a siding. The boilers are fired by Bunker C fuel oil, and a sufficient supply is carried in the mobile unit for two hours' operation so that the power can be generated before tank cars are hauled up and connected.

Generation is at 13,800 volts and a transformer is included to provide other voltages which correspond to the voltage of the existing electric distributing system at any establishment where these units may be needed.



One of the two 10,000-kw. mobile power plants built to supply power quickly wherever it may be required

NEW DEVICES

Band Filer

continuous-band filing machine for file roaching operations on metals, alloys, plas-ics, fibres and wood is being manufactured y Continental Machines, Inc., Minneapo-is, Minn. It is an all-steel welded machine nd has a throat capacity of 15½ in. with thickness capacity of 6 in. Variable-speed ulleys give the cutting speeds ranging rom 50 to 250 f. p. m. needed on different ypes of materials. Convenient controls

Continuous bands are used on this filer—Tolerances of .001-in. can be met

llow the operator to adjust work pressure nd filing speeds at any time. Tolerances f .001 in. can be obtained. File bands are urnished in 12 different sizes from ¼ in. o ⅜ in. wide in ovals, half rounds and flats. The use of these bands makes the filing op-erations continuous and adjustment on the machine permits internal or external filing.

Hydraulic Conversion Vise

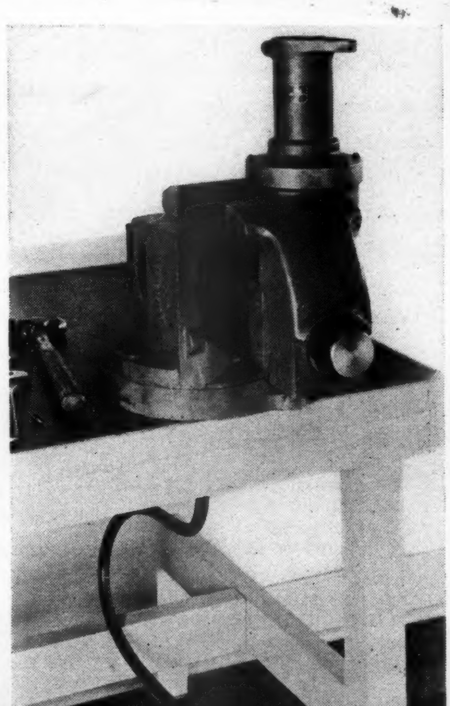
A hydraulic vise, which can be furnished s a complete new unit or for the conver-sion of present vises by installing hydraulic quipment in place of the conventional hreaded screw and handle, has recently een placed on the market by The Brucon ompany, San Francisco, Calif.

The Brucon vise conversion assembly onsists of a foot-control power unit, a teel-reinforced oil-resisting high-pressure ynthetic hose and an actuating power as-embly which replaces the former screw nd is installed in the thread chamber. The ower assembly embodies a hardened piston round between centers and lap-fitted to the ylinder.

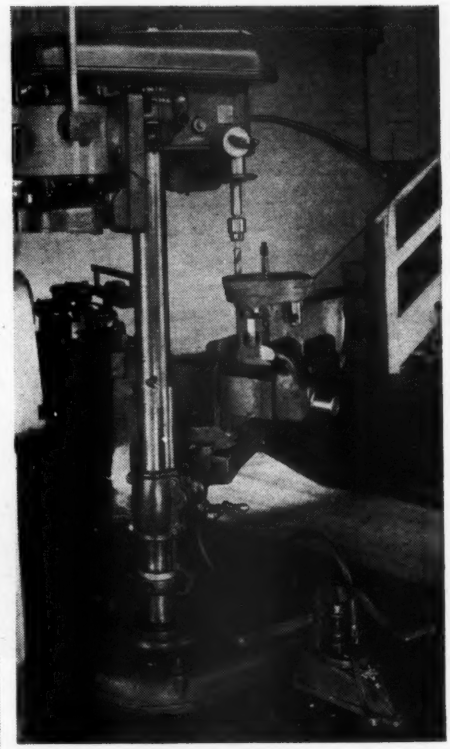
As shown in the illustration, the foot-control power unit is fully enclosed and tightly sealed against leakage. The only servicing required is said to be a change of oil once a year, since there are no leather packing or glands to wear out or become defective. All valves are serviced from the outer side. All parts are standard and re-placable when necessary.

One of the outstanding features of the Brucon hydraulic conversion is its positive, smooth, fast control with just two pedals to operate, which leaves the hands of the oper-ator, whether man or woman, free and thus promotes increased production, eliminates waste motion and reduces fatigue as well as accident possibilities. The large dual-oper-ating power pedal controls both power and speed. The initial travel of its downward movement brings the movable jaw quickly to the work and further travel develops the pressure required. The smaller positive smooth-operating foot-release valve permits the jaws to be opened to any desired posi-tion with no tendency to recoil or kick-back.

The maximum power of the Brucon con-



Brucon hydraulic conversion unit applied to a standard swivel-type bench vise



A hydraulic vise applied to the work table of a high-speed sensitive drill press

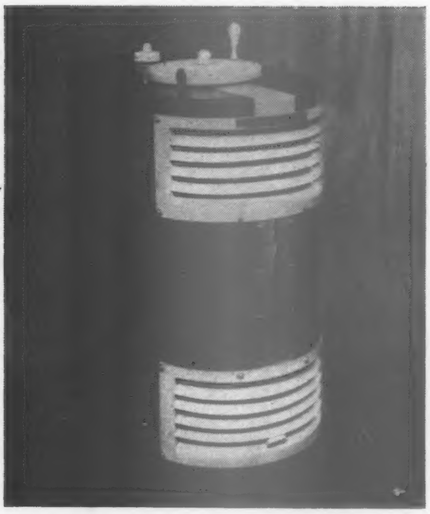
version is determined by the cylinder size which, in turn, is limited by the size of the vise in which it is to be installed, and is never great enough to break the jaws of the vise. The equipment is available in three standard models B-150, B-250 and B-350, designed for application to stationary or swivel type vises ranging from 3½ in. to 6 in. in size, with jaw openings from 4½ in. to 9 in.

Outdoor A. C. Welder

A 500-amp. outdoor alternating-current welder has been announced by the General Electric Company, Schenectady, New York. The welder has a welding current range from 100 to 625 amp. at 40 volts. A fea-ture of the welder is an "idlematic" con-trol which automatically reduces the output voltage to less than 35 volts whenever the arc is not in operation, but provides full power for welding the instant the arc is struck. This control also includes a switch operated by a handle extending through the top of the case for starting or stopping the welder manually.

The welder is protected against the en-trance of rain, snow and sleet by drip-proof construction of all openings in the top of the case and by a sealed window over the current indicator. Wide louvers

(*Continued on second left-hand page*)



The welder has a control which limits open-circuit control to 35 volts

serve not only to shed water but to keep air velocity low. All internal parts have a special finish for protection against corrosion from moist air.

The welder has built-in power-factor improvement which provides low current input by maintaining the power factor at 95 per cent or better at all loads between 40 and 70 per cent of rating. It is also equipped with finger-tip adjustment, stepless current control, fan-forced ventilation, and capacity for operation with long leads.

Self-Cleaning Drill

Substantial savings in time on drilling deep holes are said to result from the use of a device known as the Rego Karweit Driller by its manufacturer, the Bastian-Blessing Company, Chicago (30). The device may be operated at standard cutting speeds and feed rates for ordinary drills and, in some cases may be run as high as 25 per cent above conventional cutting speeds. According to the company, it is possible to drill holes to a depth 20 times the drill diameter

Self-cleaning drill which is especially useful in the drilling of deep holes

without removing the drill from the hole. The driller, which fits in place of the usual chuck, produces small uniform chips at the cutting edges of the drill instead of long spirals. The coolant or lubricant washes away these chips and bathes both sides of the cutting edges, keeping the drill cool.

Hydraulic Jacks

Thirty- and fifty-ton hydraulic jacks are now being manufactured by Templeton, Kenly and Company, Chicago. They have high and low-speed pumps which can be operated singly or in unison. Release valves are located on each side of the pumps and either release screw can be used to control

Heavy-duty, two-speed hydraulic jack

the ram return. The 30-ton model has a low height of 11 in. with an hydraulic lift of 7 in. The 50-ton jack has a low height of 12 in. and a lift of 7 in. The former weighs 65 lb. and the latter 115 lb.

Rotary Surface Grinder

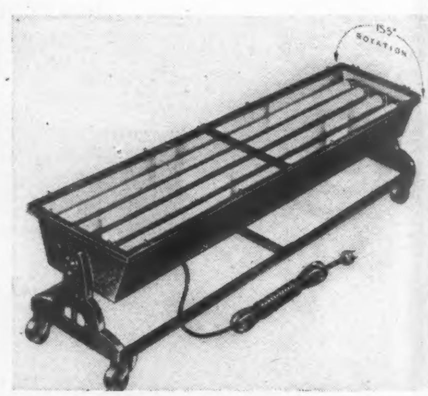
A vertical-spindle rotary surface grinder has recently been added to the line of large surface grinders made by the Hanchett Manufacturing Company, Big Rapids, Mich. Its structural proportions are made heavy and strong to insure precision and long service. A 30-in. rotary magnetic chuck is equipped with a demagnetizing switch and is traversed into grinder position by push-button control. The grinding-wheel head has hand, power or automatic traverse with power being furnished by a 2-hp. 900-r.p.m. motor. The motor-driven wet-grinding system includes a coolant pump driven by a ½-hp. motor. The grinder is equipped with a rugged swing-arm wheel dresser, an ammeter for deter-

Rotary grinder with a magnetic chuck

mining the cutting action of the grinding wheel, a floodlight and other accessories which aid in grinding to close tolerances.

Portable Fluorescent Light

A caster-mounted unit has been added to the line of portable fluorescent lights made by Day-Brite Lighting, Inc., St. Louis, Mo. Known as the Crawler, the unit consists of a covered reflector, which may be swung on its end supports through 155 deg., mounted



Crawler type portable fluorescent light

on a frame equipped with swivel casters. The baked-enamel reflectors are made for either two or four 40-watt lamps and are furnished with interchangeable vapor-tight or wire safety covers. The vapor-tight covers are clear plastic mounted in gasketed frames which are easily removable for relamping or servicing. The wire guard consists of a substantial safety screen mounted on a removable frame.

The units are supplied complete with sockets, starters, high-power-factor ballasts, a toggle switch, 20 ft. of cord and a twist-lock plug.

High Spots in

Railway Affairs . . .

Passenger Equipment May Be Authorized

In spite of everything that the Office of Defense Transportation and the railroads have done to discourage passenger traffic, particularly during the holiday season, the trains still continue to be jammed. The railroads have been putting up a determined fight to keep the equipment clean and in good operating condition, but the fight is being made against almost impossible odds. It is true that a limited amount of troop train equipment has been built, but this has afforded very little relief. The fact is that the railroads must have new equipment if they are to cope successfully with the increased passenger business. That there is a possibility of securing some relief during 1944 was recently indicated by Director Joseph B. Eastman. He not only mentioned the matter at a press conference, but an O. D. T. press release expressed the hope "that some new passenger equipment will be authorized for 1944, in view of the tremendous increase in travel and improvement in the outlook for materials."

Patterson I. C. C. Chairman

William J. Patterson has been elected chairman of the Interstate Commerce Commission for the year 1944. He spent all of his business life prior to entering government service in railroad work. Starting as a call boy he became a brakeman and then served as a locomotive fireman. Returning to work as a brakeman and switchman he later became a conductor. After 16 years in active railroad service he became a member of the staff of the Interstate Commerce Commission as a safety appliance inspector, advancing in that department until he became director of the bureau in 1934. He was appointed a member of the Interstate Commerce Commission by President Roosevelt in July, 1939.

Traffic Prospects for 1944

O. D. T. Director Eastman has characterized the performance of the railroads as "a superlative job." He feels quite decidedly, however, that the railroads are "not over the hump." O. D. T. estimates that the freight traffic in 1944 will amount to 757 billion revenue ton-miles, an increase of three per cent over 1943. Travel, including organized troop movements, is expected to total about 100 billion revenue passenger-miles, an increase of about 15 per cent. It is for this reason that the O. D. T. is pressing its drive for an increase of 10 per cent in railroad efficiency. Mr. Eastman ascribes credit for the remarkable job that has been done to securing maximum utilization of the equipment, co-operation of the transportation companies with each other, excellent co-operation of the shipping public and "to a lesser extent, the traveling public."

Express by Air

The Railway Express Agency reported that the air express cargo handled in the co-ordinated rail-air express service increased 16.9 per cent in October, compared with the same month in 1942. There were 36,585 shipments moved in this combination service, compared with 31,292 in October, 1942. The express charges for this service were 25 per cent higher. It is estimated that these combination rail-air shipments make up, roughly, about 30 per cent of all of the air express shipments.

Operating Records Broken

The reconds being piled up by the railroads continue to show marvelous results. The construction work on war plants has, of course, been largely completed and this should have a tendency to level off the railroad volume. The Car Service Division of the Association of American Railroads presented the following interesting facts before a meeting of the association in Chicago on December 2:

1. In the first eight months of 1943 carloadings were below the same period last year, the aggregate reduction being 778,000 cars or 2.7 per cent. Yet ton-miles in the same period increased 73 billion, or 18 per cent.
2. Miles per car-day averaged 51 in the first nine months of 1943, the highest number of miles on record.
3. The percentage of empty mileage in the first eight months of 1943 was down to 36.4, versus 37.4 in 1942 and 37.3 in the same period of 1941.
4. For the first six months of 1943 the average haul per ton of freight was 502 miles against 444 in 1942.
5. For the first six months of 1943 the average tons per car of carload freight was 40.9 compared with 39.2 in 1942.
6. The average turn-around time of serviceable cars, while higher in the first six months due to longer hauls, has decreased from 13.7 days in July to 13.2 days in October. These averages are below those for the same periods last year except for October, 1942, when it was 13.1. There are some indications that the average haul is decreasing, which will make possible more frequent loading of available cars.

Illinois Central Cited for Safety

The National Safety Council for the first time has made a distinguished service and safety award to a major railroad making the greatest reduction in total employee casualty rates for the first seven months of the year. The Illinois Central was the recipient. Reportable accidents dropped from 473 for the first seven months of 1942 to 436 for the corresponding period this year. This was done in the face of considerable increase in the number of employees and man-hours worked. On the basis of million man-hours worked, the Illinois Central's ratio of personal injuries dropped from 9.18 during the first 10 months of 1942 to 6.88 for the same period of 1943.

Wartime Passenger Travel

Passenger travel on the railroads of this country reached its peak for the First World War in 1918. Prior to 1942 the all-time record was made in 1920 with 46,847,534,000 passenger-miles. This year it will almost double the total for 1918, with an estimated 80 billion passenger-miles. According to the Railway Age, troop movements in 1942 were four times heavier than in 1918 and this year they will be about 70 per cent higher than in 1942. These records have been made in spite of the fact that O. D. T., the A. A. R. and individual railroads have done everything they could to discourage unnecessary travel. The intense utilization of the equipment is indicated by the fact that in spite of the great increase in traffic, it is being handled by much fewer passenger carrying cars—27,922 on January 1, 1943, as compared to 41,733 on January 1, 1920.

1943 Railway Records

The total operating revenues of the railways of this country during 1943 amounted to more than nine billion dollars, thus marking an all-time high. The net income was about 880 million dollars, or somewhat less than for 1942 or 1929. It was, however, considerably more than twice as great as for the year 1918, when the railroads were under government operation. Revenue passenger-miles amounted to 85 billion in 1943, as compared to 53 billion, 658 million in 1942; or twice as large as in the war year 1918, when they amounted to 42 billion, 676 million. Revenue ton-miles in 1943 amounted to 725 billion, as compared to a little less than 638 billion in 1942 and 405 billion, 379 million in 1918.

(*Turn to second left-hand page*)

NEWS

Expect 50,000 Freight Cars in 1944; 30,000 All-Steel

The War Production Board during the week ended December 11 approved the construction of all-steel freight cars in the 1944 program, thus abandoning the policy of insisting that the railroads order the so-called composite-type cars, and confirmed previous predictions that in 1944 production of freight cars for domestic use will total approximately 50,000 cars.

The 50,000 figure is built up out of the some 34,000 cars now scheduled, plus some 5,000 ordered but not definitely scheduled for production, plus some 10,000 which are expected to be ordered since proposals to extend the five-year amortization plan on railway equipment have been adopted. While the material situation has now eased to the point where allocations could perhaps be obtained for more than 50,000 cars, it is not expected that car-building facilities for more than that number for domestic service will become available next year.

The all-steel cars will get into production next June and 30,000 of the 1944 total would be of that type. "The new steel cars, made possible by an available supply of that metal, and a concomitant shortage of lumber," the WPB announcement says, "will be known as the 'victory design.' Railroad men expressed themselves as being pleased at the prospect of being able to obtain these new all-steel cars primarily because they will considerably reduce the maintenance necessary on the composite type, and in addition they will carry approximately 300 cubic feet more freight. Equally important, from the standpoint of the manufacturers, is the fact that the all-steel car takes less time and manpower to construct."

Aluminum Research Laboratories Celebrate Twenty-Fifth Birthday

The twenty-fifth anniversary of the founding of Aluminum Research Laboratories by the Aluminum Company of America was celebrated on December 16 with an open-house at the laboratories during the afternoon for a large number of local residents of New Kensington, Pa., where the laboratories are located, and with a dinner in the evening at the University Club, Pittsburgh, Pa., for the employees of the laboratories.

Throughout the 25 years of their existence Aluminum Research Laboratories have been under the direction of Dr. Francis C. Frary. They have grown from an initial group of five in 1918 to several hundred men and women who, since 1930, have occupied a modern laboratory building at New Kensington, with smaller branches at Cleveland, Ohio, and East St. Louis, Ill. During the 25 years the laboratories have developed new aluminum alloys, each with distinctive properties adapting it to use in new industrial or structural applications, as well as new processes of producing aluminum and of finishing aluminum surfaces, and new laboratory techniques.

Dr. Francis C. Frary, director of research, Aluminum Company of America

At the dinner Dr. Frary was presented with a 25-year service button by Roy A. Hunt, president of the Aluminum Company of America. Dr. Frary responded with a review of 25 years of research in aluminum. The guests were also addressed by Dr. E. R. Weidlein, director, Mellon Institute, and Dr. Webster N. Jones, director, College of Engineering, Carnegie Institute of Technology, on future aspects of research in general. Arthur V. Davis, chairman of the board of the Aluminum Company of America, was also a speaker. S. K. Colby, vice-president, was toastmaster. The company was host to a group of research directors from other industries and to representatives of the business, magazine and daily press.

A. A. R. Mechanical Division

Linseed Oil Available for Wheel-Mounting Lubricant

The secretary of the A. A. R. Mechanical division recently sent out to the member roads, private car owners and car builders a circular letter, referring to WPB Order M-332, dated June 17, 1943, which restricts the processing of linseed oil for general use, and the A. A. R. Specifications for wheel and axle mounting lubricant which call for a mixture of 12 lb. of white lead to one gallon of boiled linseed oil. According to the secretary, the matter has been discussed with representatives of the War Production Board, who advise that Order M-332 is not intended to prevent the use of the present standard wheel-mounting mixture by railroads and that, while the broad language of the order appears to interfere, an exemption will be granted immediately upon application by any linseed oil supplier who in the application will state that the oil in question is intended for use in a wheel-mounting mixture and not for use in paint. It is requested that such applications be by letter, in triplcate, directed to the War Production Board, Chemical Division, Attention Administrator Order 332, Washington, D. C.

Precaution Against Brake Beams Dropping

In a circular letter, dated December 8, to members of the A. A. R. Mechanical division and to private car owners, V. R. Hawthorne, executive vice-chairman of the division calls attention to the importance of properly maintaining brake-beam hangers and means of securement, including bottom rod and brake-beam supports, as a precaution against brake beams dropping in service.

With the U-type hanger, it is common practice to use hanger pins of the bolt-type, as shown on Page E-5-1937 of the A. A. R. Manual, secured by a common nut or (alternate) ⅜-in. cotter. In the case of hanger pins secured by cotters, it is frequently found that the cotter and hole are badly worn or cotters are under size (sometimes as small as ⅛ in.) either of which constitutes a contributory cause for failure

f the brake-beam suspension, due to loss of e hanger pin, when cars are permitted to ontinue in service in this condition. It is rged, therefore, that all concerned be instructed to pay particular attention to this etail, making replacements of all worn or nder-size cotters with *cotters of not less han ⅛ in. size,* properly spread. When rs are in shops or on repair tracks, anger pins secured by common nuts should ave the pin ends peened over or nuts tackelded to the pin. Where hanger pins, seured by cotters have cotter holes badly orn, cotters of the next larger size (7/16 n.) should be substituted, the holes being eamed to suit if necessary. Where other eans of securement are employed, such as lotted pins with flat, split, or riveted keys, he parts should be maintained in serviceble condition at all times.

Directly related to the above is the natter of proper maintenance of brakeeam and bottom-rod supports, specifically eferred to in a circular letter dated April , 1943. The vice-chairman states that reorts continue to come in indicating that hese devices are not receiving proper atention, therefore, any instructions which nay have been issued on the basis of the ircular letter referred to, should be suplemented as necessary, in order that the ituation may be adequately protected.

Painting of Truck Sides—Removal of Heavy-Base Paints

In a letter, issued under date of Decemer 8, to members of the A. A. R. Mechancal division, the secretary of the division tates that, effective August 1, 1943, a secnd note was added to Par. (3) Sec. (t) f Interchange Rule 3, reading as follows: 'Note 2.—New or second-hand truck sides r other truck parts must not be painted with heavy asphaltic, tar, or cement-base aints which prevent detection of flaws in rdinary inspection. If such parts are ainted, only light-bodied paints may be sed."

This requirement is brought to the speial attention of the membership because of he safety hazard involved in failures of ast-steel side frames and other truck parts ecause of defects which it is frequently mpossible for inspectors to detect where eavy base paints have been used. Attenion is also directed to the fact that a numer of cars are now moving in interchange ervice which have trucks painted with eavy base paints or heavily encrusted with cale or rust. When such cars are shopped r repainted, it is both desirable and essenial that all heavy-base paints, as well as ust and scale, be removed from truck sides nd other truck parts by sandblast or other ffective method, the parts carefully inspected and light-bodied paint applied, in rder to facilitate inspection and detection f flaws.

Safety Appliance Letter Ballot Results

The secretary's office of the A. A. R. Mechanical division has just announced avorable results of the safety appliance etter ballot sent out to the membership in Circular D. V.—1054 under date of Noember 5. This letter ballot covered a single proposition to adopt as standard the specifications for running boards other than wood for box and other house cars, and for foot boards other than wood for locomotives and tenders in switching service, together with the enforcement provision, recommended by the Committee on Safety Appliances and authorized by the General Committee, for inclusion in Interchange Rule 3. This proposition was unanimously approved by the letter ballot and is effective January 1, 1944.

Specifications for Running Boards Modified

Making a second report on further hearing in the No. 21997 proceeding, the Interstate Commerce Commission, Division 3, has modified its order of March 13, 1911, with respect to running boards and dimensions and manner of application to box and other house cars, and with respect to dimensions of footboards on steam locomotives.

The principal modification will permit the installation of running boards of material other than wood on box and other house cars and footboards of material other than wood on locomotives used in switching service without prior approval of the commission. The report, dated December 11, 1943, became effective January 1.

A.S.M.E. Railroad Division Elects Officers

At the annual meeting of the American Society of Mechanical Engineers, Railroad Division, held at New York on December 2 and presided over by Chairman J. R. Jackson, engineer of tests, Missouri Pacific, the following officers were installed for the coming year: Chairman J. G. Adair, mechanical engineer, I. C. C., Washington, D. C.; members of Executive Committee RR1, in addition to the chairman: W. M. Sheehan, assistant vice-president, General Steel Castings Corporation, Eddystone, Pa.; K. F. Nystrom, mechanical assistant to vice-president, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; Lt. Col. W. C. Sanders, general manager, Timken Roller Bearing Company, Railroad Division, Canton, Ohio; P. W. Kiefer, chief engineer of motive power and rolling stock, New York Central, New York. E. L. Woodward, western mechanical editor, Railway Age and *Railway Mechanical Engineer,* continues as secretary.

Incoming new members of the General Committee RR2, with terms expiring in 1948, include: E. R. Battley, general superintendent of motive power and car equipment, Canadian National, Montreal; E. S. Pearce, president, Railway Service & Supply Corporation, Indianapolis, Ind., and W. H. Baselt, mechanical assistant to the vice-president, American Steel Foundries, Chicago. By action of the Executive Committee at a recent meeting in Chicago, H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy, Chicago, has been appointed a member of the A. S. M. E., Railroad Division, General Committee, in place of H. P. Allstrand, deceased, Mr. Urbach's term expiring in 1946. C. M. Darden, superintendent of machinery, Nashville, Chattanooga & St. Louis, Nashville, Tenn., has also been appointed a member of the General Committee to fill the vacancy caused by advancing Mr. Kiefer to the Executive Committee. Mr. Darden's term will expire in 1947.

Miscellaneous Publications

Safety Code for Jacks.—The American Standards Association, 29 West Thirty-ninth street, New York, has approved a new standard Safety Code for Jacks (B30.1-1943), which has been prepared by a subcommittee of the Section Committee on a Safety Code for Cranes, Derricks and Hoists. The requirements of the standard are merely precautionary, not design specifications. The code applies to the construction and use of all portable, manually operated jacks of the lever-and-ratchet, screw and hydraulic types, except those supplied with automobiles as part of their standard tool equipment. The price of the standard is 30 cents.

A. A. R. Divisions to Meet in 1944

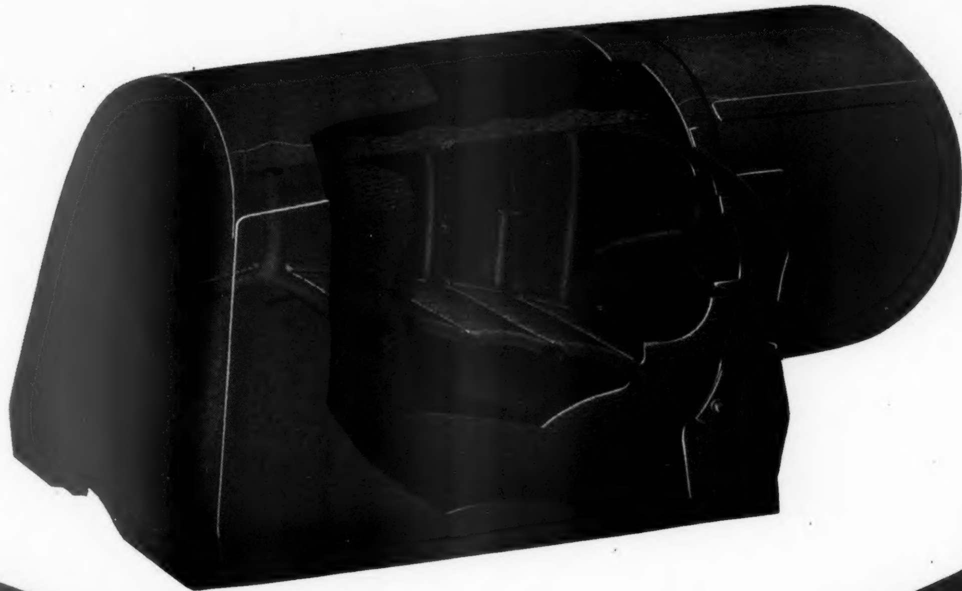
In a communication addressed to the chairman of the Operating-Transportation, Engineering, Mechanical, Purchases and Stores, and Freight Claim divisions of the A.A.R., C. H. Buford, vice-president, operations and maintenance, suggests that these groups arrange to hold annual meetings during 1944. This action is prompted, as stated in the letter to the executive officers of the divisions, by the record traffic that is now being handled and that will probably continue, and the rising trend of accidents and freight claims, pointing to the growing necessity for more attention to the maintenance of roadway and equipment. The letter suggests also that attention be given to "future problems with which the railroads will be faced incident to adjustments and developments occurring after the war is over."

In accordance with this suggestion, the General committee of the Mechanical division, at a meeting on December 1, decided to hold a two-day member meeting in Chicago next June. Meetings of the other divisions are also being arranged.

Prospects Good for More Equipment and Materials in 1944

There will be plenty of materials for equipment by the end of 1944, according to John J. Pelley, president of the Association of American Railroads, at a press conference following the annual meeting of the Association at Chicago on December 2. He said that while the War Production Board had promised more material for cars and locomotives, new coaches could not be expected until late in 1944. By that time there will be plenty of material for all-steel freight cars as well, he stated.

(*Continued on second left-hand page*)



ide

pread adoption of Security Circulators

1. **FOR POSITIVE FLOW OF WATER OVER CENTER OF CROWN SHEET**
2. FOR REDUCED HONEYCOMBING
3. FOR REDUCED FLUE PLUGGING
4. FOR REDUCED CINDER CUTTING
5. FOR BETTER ARCH BRICK SUPPORT

...ALL OF WHICH RESULTS IN GREATLY INCREASED LOCOMOTIVE AVAILABILITY

COMPANY, INC.

SECURITY CIRCULATOR DIVISION

Mr. Pelley said that the manpower problem is now especially serious in certain localities including the Pacific Coast states, where shortages are interfering with locomotive operation.

Director Joseph B. Eastman of the Office of Defense Transportation foresees for 1944 an improved situation with respect to the production of railroad equipment and supplies, including perhaps opportunities for the acquisition of some new passenger cars. Discussing the outlook at a December 20 press conference, the ODT director cited such favorable developments as the easing materials situation, plans for better control of production schedules to minimize "slippages" experienced in the past, and President Roosevelt's executive order continuing under War Production Board authority arrangements to amortize war facilities over a five-year period.

Lately, Mr. Eastman said, the ODT has been having difficulty getting from the railroads sufficient orders to take up the equipment allocated. He explained, however, that the railroads' reluctance to place orders was due in large part to uncertainties as to whether the five-year amortization privileges would be continued, following the recent termination of the War and Navy departments' roles as certifiers. Clarification came in President Roosevelt's December 17 executive order transferring to the chairman of the WPB the authority to issue the required necessity certificates. The railroads, too, "like many others," Mr. Eastman continued, began to see the end of the war and to think about the time when they would have to resume normal competitive operations. Hence they looked more critically at the equipment being offered, which "has not been 100 per cent of the best type." But this situation, Mr. Eastman thinks, will also improve. Moreover, the ODT expects that it may get more alloy steels for use in freight car and locomotive construction during 1944.

"The railroads feel and we are inclined to feel," Mr. Eastman added, "that sufficient provision will be made for locomotives. We are more concerned about box cars." In the latter connection, he pointed out that there has been a shortage of cars to move the grain crop. Also, he noted that freight-car construction in this country has been at a high level, but much of the equipment has been going abroad under lend-lease arrangements or to the American forces. A substantial amount has gone to Russia, he said.

Mr. Eastman's optimistic reply to the question about the prospects for new passenger cars next year was based on the easing of the aluminum situation. Meanwhile, a press release issued in connection with the press conference expressed ODT's hope "that some new passenger equipment will be authorized for 1944 in view of the tremendous increase in travel and improvement in the outlook for materials."

Orders and Inquiries for New Equipment Placed Since the Closing of the November Issue

Locomotive Orders

Road	No. of Locos.	Type of Loco.	Builder
Baltimore & Ohio	6[1]	660-hp. Diesel-elec.	American Loco. Co.
	7[1]	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Canadian National	10	Diesel-elec. switch	American Loco. Co.
	20	2-8-2	Montreal Loco. Wks.
Chicago & North Western	3	380-hp. Diesel-elec.	Whitcomb Loco. Co.
Reading	5	5,400-hp. Diesel-elec. frt.	Electro-Motive Corp.
St. Louis Southwestern	3[1]	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Union Pacific	5	4-8-8-4	American Loco. Co.
	10	4-8-4	American Loco. Co.
	20	4-6-6-4	American Loco. Co.
Western Maryland	3	1,000-hp. Diesel-elec.	American Loco. Co.
	3	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.

Locomotive Inquiries

Road	No. of Locos.	Type of Loco.	Builder
Wabash	1[1]	660-hp. Diesel-elec.	....
	3[1]	1,000-hp. Diesel-elec.	....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Canadian National	1,450	Box	Canadian Car & Fdy. Co.
	1,350	Box	National Steel Car
	250	Box	Eastern Steel Car
	750	70-ton hopper	Eastern Steel Car
	200	Flat	Canadian Car & Fdy. Co.
	200	Refrig.	Co. shops
	200	Auto.	Pressed Steel Car Co.
	300	Gondola	Pressed Steel Car Co.
Chicago, Milwaukee	200	Auto-box	Co. shops
St. Paul & Pacific	500	Hopper	Co. shops
Illinois Central	600[3]	50-ton hopper	Co. shops
New York, New Haven & Hartford	50	Steel caboose	Pullman-Std. Car Mfg. Co.
Northern Pacific	750	50-ton box	Pullman-Std. Car Mfg. Co.
	250	50-ton box	Pressed Steel Car Co.
Oliver Iron Mining Co.	50	Air-dump	Austin-Western Road Machy. Co.
Reading	1,000	Hopper	Co. shops
	1,000	Gondola	Co. shops
	50	Caboose	Co. shops
St. Louis-San Francisco	250	50-ton composite gondola	Co. shops
Seaboard Air Line	200	50-ton steel box	Pullman-Std. Car Mfg. Co.
	200	70-ton hopper	Pullman-Std. Car Mfg. Co.
Southern Pacific	200[4]	50-ton composite gondola	Pressed Steel Car Co.
Union Pacific	100[5]	Caboose	Pullman-Std. Car Mfg. Co.

[1] Subject to WPB authorization.
[2] Order provides for completion of four cars a day starting January, 1944.
[3] Deliveries scheduled for May and June.
[4] For the Texas & New Orleans. Deliveries reported scheduled for second quarter of 1944.
[5] Deliveries reported scheduled for third quarter of 1944.

WPB Appointment

Lemuel R. Boulware, who has deputy controller of shipbuilding for War Production Board, has been appointed operations vice-chairman succeeding Hi G. Batcheller. The Transportation Equipment Division is one of the WPB units to come under Mr. Boulware's direction.

Locomotive Builders Told to Use More Copper to Speed Work

Builders of locomotives and component parts thereof have been cautioned by WPB not to apply too rigidly the prohibition against copper in locomotive parts. Copper may be used if it will prevent delay in production schedules. E. W. Roath, Administrator of M-9-c, has notified all manufacturers of locomotives and component parts as follows:

"We have been advised by the Transportation Equipment Division of the WPB that manufacturers of locomotives and component parts have interpreted paragraph (c) (1) of Conservation Order M-9-c so rigidly that it has greatly delayed the production of vital equipment.

"Paragraph (c) (1) of Order M-9-c has the effect of prohibiting the use of copper or copper-base alloy in the manufacture of component parts for locomotives only in instances where the production of such parts from a less scarce material is practical. The use of a less scarce material is not, however, deemed to be practical if the substitution causes an excessive delay in the production of an essential locomotive component part, or appreciably reduces the efficiency of the part.

"The above statement is not applicable to articles or uses included on the Combined List inasmuch as Paragraph (a) prohibits the use of copper or copper-base alloy in the production thereof. Non-operating and decorative uses, or use for installations and equipment, mechanical or otherwise, such as bases, frames, guards, standards and supports, have been included on the Combined List."

WPB Steel Orders and Allocations

Following an announcement that the War Production Board had released its allocations of steel for the first quarter of 1944 under the Controlled Materials Plan, the Office of Defense Transportation on November 21 explained that the domestic transportation industry would receive in that quarter a total of 1,564,000 tons of carbon steel, as compared with 1,380,000 tons for the fourth quarter of 1943 and 1,200,000 tons for the third quarter.

Necessary amounts of alloy steels, copper and aluminum also have been allocated for use along with the carbon steel, it was explained.

Acting upon requests from railways operating under Order P-142, the War Production Board has authorized the railways to place orders for carbon steel, including wrought iron but excluding rail and track

ccessories, for the third and fourth quarters f 1944, to the extent of 30 per cent of the mounts authorized for the fourth quarter f 1943. "Under this authorization," the otice reads," you [the railroads] are imited in total amount of advance orders or carbon steel but not in classes of carbon teel. For example, you may place ad-ance orders for 100 per cent of your re-uirements of carbon steel plates provided our advance orders for *all* types of carbon teel, exclusive of rail and track accessories, o not exceed the 30 per cent allotment . . . of carbon steel (exclusive of rail and track accessories) you were authorized to purchase on Form WPB-2585, original and supplements for the fourth quarter of 1943."

The WPB, according to the November 21 explanation, expects that production of locomotives, trucks, buses, and automotive replacement parts will be speeded up through a faster flow of raw materials into the builders' plants resulting from its decision to assign an AA-1 priority rating to such equipment. The ODT asserted that locomotives will be built in the first quarter of 1944 to the full capacity of the builders' plants after war needs are met.

The use of steel in the maintenance of steel cars has also been authorized by WPB thus eliminating its earlier requirements that wood should be used in replacements of certain parts.

The War Production Board has also approved the construction of all-steel freight cars beginning with the second quarter of 1944, thus abandoning its practice of insisting that railroads order composite-type cars.

Supply Trade Notes

Allegheny-Ludlum Steel Corpora-tion.—*E. L. Huff,* formerly electrical en-gineer at the Brackenridge, Pa., plant has been appointed chief engineer of all Alle-gheny-Ludlum plants.

◆

Gould Storage Battery Company.—*J. H. Hamilton,* former sales agent for the National Cash Register Company, has been appointed sales representative in the San Francisco, Calif., territory, for the Gould Storage Battery Corporation.

◆

Turco Products, Inc.—*Dr. Nathaniel Baum* has been appointed head of a new organic research department which Turco Products, Inc., has opened in its Los Angeles, Calif., laboratory, to keep pace with new problems in the railroad and allied industries. Doctor Baum had been a consulting chemist in organic synthesis and resin in Chicago for the last six years.

◆

Edward G. Budd Manufacturing Co.—*John E. Wright* has been appointed to fill the recently created office of regional sales manager of the railway division of the Budd Company, with headquarters in the Railway Exchange building, Chicago. *Thomas Henkle* continues as special representative in Chicago. *Thomas R. Wagner,* former vice-president of the Peerless Equipment Company of Chicago, has become district sales manager of the railway division, with headquarters at Chicago, and *Robert Sherman* has been appointed district sales manager of the Railway division at St. Louis, Mo. *Samuel M. Felton* continues as general manager of the Railway division of the Budd Company, with headquarters at Philadelphia, Pa.

John E. Wright

John E. Wright is a graduate of George Washington University. He formerly represented the American Steel Foundries in the Southwest territory, resigning early in 1943 to take charge of the St. Louis, Mo., office of the Budd Company.

Thomas R. Wagner was a graduate of Cornell University in 1918. He served with the Marines in World War I and during his early career was associated with the Cornell Wood Products Company and the Sun Oil Company. He later joined the Sinclair Refining Company, serving as salesman, western manager of the railway sales department, and assistant district manager. He then resigned to become vice-president of the Peerless Equipment Company.

Thomas R. Wagner

Robert Sherman attended Princeton University and the University of Virginia. He joined the Commonwealth Steel Company, now the General Steel Castings Company, Granite City, Ill., in 1927, working in the engineering and production departments. He entered that company's sales department in 1930 and continued in sales work until his appointment as district sales manager in charge of the St. Louis office of the Budd company.

Robert Sherman

◆

Graybar Electric Company.—*R. B. Sayre* has been appointed manager of the Memphis, Tenn., office of the Graybar Electric Company. Mr. Sayre joined the Memphis office as a warehouse clerk in October, 1921, and two years later was appointed salesman serving the north Mississippi, west Tennessee, and Arkansas territory. He was transferred to Atlanta, Ga., as manager, outside construction department in 1939, which position he has held until his recent appointment.

◆

Pullman-Standard Car Manufacturing Company.—*James B. Rosser,* sales agent of the Pullman-Standard Car Manufacturing Company, Chicago, has been appointed administrative assistant, reporting directly to the president.

Army-Navy E Awards

A. M. Byers Company, Pittsburgh, Pa. Renewal star.

Baldwin Locomotive Works, Standard Steel Works division, Philadelphia, Pa. Fourth star.

Independent Pneumatic Tool Company. Second star.

AMERICAN CAR AND FOUNDRY COMPANY.—*Victor R. Willoughby*, vice-president, formerly in charge of engineering, has been assigned as director of research and development. *Edmund D. Campbell*, general mechanical engineer, has been appointed vice-president in charge of engineering. *Alvin A. Borgading*, general purchasing agent, has been appointed vice-president in charge of purchases. *J. A .V. Scheckenbach*, assistant vice-president in charge of operations, and *R. A. Williams*, district sales manager at Cleveland, Ohio, have also been appointed vice-presidents, with headquarters at New York. *W. F. Dietrichson*, as-

Edmund Dana Campbell

sistant general mechanical engineer at Berwick, Pa., has been appointed mechanical engineer for the company, with headquarters at Berwick. *Allen W. Clarke*, mechanical engineer in charge of the western engineering division of the American Car and Foundry Company, has been appointed assistant general mechanical engineer, with headquarters at St. Charles, Mo.

Alvin A. Borgading

A. G. Wood, sales agent at Chicago, has been appointed district sales manager, with headquarters at Washington, D. C. *Dudley L. O'Brien*, sales agent at Cleveland, Ohio, has been appointed district sales manager of the Cleveland office.

Edmund Dana Campbell was a graduate of Pennsylvania State College with the degree in mechanical engineering in 1903. He received a master's degree from that college in 1907. He served a short apprenticeship in the steel car shops of the American Car and Foundry Company at Berwick, Pa., and from 1905 to 1908, worked in the engineering department at the Ber-

John A. V. Scheckenbach

wick plant and later at Milton, Pa., and in New York. He was transferred to the office of the chief mechanical engineer at St. Louis in 1909 and continued there until May, 1917. During the first world war, Mr. Campbell was commissioned a captain in the Engineers Officers Reserve Corps and was later assigned to the engineering division of the Ordnance department in Washington, D. C. He was promoted to major in May, 1918, and commissioned a lieutenant-colonel in the Ordnance Reserve Corps in 1919. He became a full Colonel in 1931, but has since resigned. He returned to the American Car and Foundry Company in 1919 as assistant engineer in the New York office and in 1920 went to St. Louis to organize the mechanical department. He was appointed assistant general mechanical engineer at Berwick in August, 1933, and general mechanical engineer at New York in March, 1938. Mr. Campbell is the author of several articles on railway artillery and railroad equip-

R. A. Williams

ment. He is a member of the General Committee of the Railroad Division of the American Society of Mechanical Engineers; a member of the Army Ordnance Association; a member of the New York Railroad Club, and a director of the Sterling Steel Castings Company.

Alvin A. Borgading has been associated with the American Car and Foundry Company since 1907 when he began work in the company's St. Louis, Mo., office. He transferred to the New York office as buyer for the purchasing department in 1918, and was appointed chief clerk of the purchasing

W. F. Dietrichson

department in 1923. He became assistant to the purchasing agent in 1939 and general purchasing agent in December, 1942.

John A. V. Scheckenbach received his early education in European schools and is a graduate mechanical engineer of Polytechnic, Germany. He joined the American Car and Foundry Company in 1909 as construction engineer in the field and, from 1911 to 1929, was in charge of all improvements and new construction in a.c.f. plants.

Allen W. Clarke

During the first world war, he was appointed supervisor and consulting engineer in the construction of shell plants for the company and its affiliates. He traveled extensively throughout Europe for the company during 1925-26 and was appointed assistant vice-president in charge of operations in May, 1929. When a.c.f. took over the American Welding Company in May,

(*Continued on next left-hand page*)

1939, Mr. Scheckenbach was elected a vice-president in charge of production of forge-welded vessels and containers.

R. A. Williams studied railway mechanical engineering at Pennsylvania State College and Washington University, St. Louis, Mo. He joined the estimating and engineering department of the American Car and Foundry Company at St. Louis, Mo., in 1924 and was transferred to the St. Louis sales department as sales engineer in 1928. He was appointed district sales manager of the Cleveland office in June, 1936. While in charge of that office Mr. Williams worked directly with the Army Transportation Corps in Washington on the sale of railroad cars for service here and abroad. He is now located in New York as assistant to *William L. Stancliffe,* vice-president in charges of sales.

W. F. Dietrichson was born in Oslo, Norway, and was a graduate of the Oslo Technical College in 1907, in which year he came to America. He was a draftsman for the Standard Steel Car Company from 1908 to 1912. He joined the general mechanical engineering office of the American Car and Foundry Company at St. Louis, Mo., in 1912, working as checker and calculator for the ensuing five years. He entered the engineering office at New York as assistant engineer and mechanical engineer. He served as mechanical engineer at the Berwick plant from 1932 to 1933, and was placed in charge of the western engineering division in 1933.

Dudley L. O'Brien was formerly employed on the Chesapeake & Ohio. He entered the operating department of the Huntington, W. Va., plant of the American Car and Foundry Company in March, 1919. He was transferred to the sales department and worked in the field from 1931 to 1937. In the latter year Mr. O'Brien was appointed sales agent in the Southwestern territory. He was appointed sales agent at the Cleveland office in October, 1942.

Dudley L. O'Brien

A. G. Wood entered the Berwick, Pa., shops of the American Car and Foundry Company in May, 1917. He was assigned to electric rivet heater service and sales in Chicago in September, 1920, continuing there until 1931 when he was transferred to the Chicago sales department as sales agent.

A. G. Wood

U. S. Army in 1917, and served with the U. S. Ordnance department in France as captain and major until July, 1919. He acted also as Ordnance observer for railroad artillery abroad. Following the war, he re-joined the American Car and Foundry Company as assistant mechanical engineer at the St. Louis, Mo., plant. He was appointed assistant general mechanical engineer in 1938.

Allen W. Clarke was a graduate of Purdue University in 1907, from which institution he received a master's degree in mechanical engineering. His association with the American Car and Foundry Company began in the summer of 1905. Following graduation he served in the engineering department at the Jeffersonville, Ind., plant until 1908, and in the office of the chief mechanical engineer at the St. Louis, Mo., plant from 1908 to 1911. He was chief draftsman and subsequently local engineer at the Jeffersonville plant from 1911 to 1928, when he was transferred to the en-

◆

American Brake Shoe Company.—*William A. Blume,* president of the American Brakeblok division of the American Brake Shoe Company since 1940, has been elected a Brake Shoe vice-president. Following his graduation from Penn State College in 1915, Mr. Blume became associated with the Brake Shoe Company as a special apprentice at its Mahwah, N. J., foundry. He was subsequently sent to the company's munition plant in Pennsylvania and then back to Mahwah where he worked in the experimental department. After serving with the Engineering Corps in the world war, he returned to Brake Shoe in August, 1919, and was appointed assistant superintendent at the Baltimore, Md., foundry. He was transferred to Pittsburgh, Pa., in 1924 where he was one of a group carrying on experiments with a composition railway brake shoe. When the American Brake Materials Corporation was established in 1926, he was appointed vice-president in charge of engineering. The company was later moved to Detroit, Mich., as American Brakeblok. Mr. Blume was elected a vice-president of American Brakeblok in 1932, and president in May, 1940. His new appointment as vice-president of American Brake Shoe Company is in addition to his position as president of the American Brakeblok division.

◆

American Steel & Wire Company.—*Robert Murray,* superintendent of the New Haven, Conn., works of the American Steel & Wire Company, subsidiary of the U. S. Steel Corporation, has been appointed assistant division metallurgist in Cleveland, Ohio.

◆

Templeton, Kenly & Company.—*A. C. Lewis,* special representative in the sales department of the Railway & Power Engineering Corp., Ltd., has resigned to become vice-president in charge of sales of Templeton, Kenly & Company, Chicago. Mr. Lewis entered the employ of Templeton, Kenly in 1912 and later opened a Canadian plant in Toronto, Ont., for the manufacture of the company's jacks. When Canadian manufacturing was discontinued temporarily in 1915 and the plant's equipment was sold, Mr. Lewis resigned to form the A. C. Lewis Company, Ltd., Canadian distributor for Simplex jacks. In 1917 he became an officer in the Third Canadian Infantry Battalion, Toronto regiment, in France and upon being wounded at Amiens on August 8, 1918, was removed to a hospital in Canada. Upon his discharge from the hospital, he returned to his business. When, in 1928 the Railway & Power Engineering Corp., Ltd., took over the assets of A. C. Lewis Company, Ltd., including the distribution of Templeton, Kenly & Company products, Mr. Lewis became special representative of the sales department.

A. C. Lewis

◆

Link-Belt Company.—The Link-Belt Company has purchased the manufacturing plant and inventory of the Link Belt Supply Company, Minneapolis, Minn., authorized distributor of Link-Belt products in Minneapolis, St. Paul, Minn., and adjacent territory since 1900. *Ray S. Wood,* district manager of the positive drive division, with headquarters in Detroit, Mich., has been appointed plant manager. *Edward J. Burnell,* formerly vice-president and general manager in charge of operations of the

(Continued on fifth right-hand page)

Pershing Road plant and central division sales in Chicago, has been transferred to the executive offices in Chicago as vice-president in charge of sales. *Harold L. Hoefman,* manager of the company's Atlanta, Ga., plant, will succeed Mr. Burnell as general manager of the Pershing Road plant, and *Richard B. Holmes,* district manager at Indianapolis, Ind., has been appointed manager of the Atlanta plant to succeed Mr. Hoefman. *David E. Davidson,* district engineer at the Detroit office, has been named district manager at Indianapolis.

◆

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—*C. F. Lloyd,* manager of the central station and transportation departments, has been appointed manager of the company's general contract department and *Tomlinson Fort,* formerly assistant to Mr. Lloyd, has been appointed manager of the central station department.

◆

CINCINNATI PLANER COMPANY.—The following companies have been appointed exclusive sales representatives of the Cincinnati Planer Company in the North East: *Harrington-Wilson-Brown Co.,* Chrysler Building, New York City, for Northern New Jersey, eastern New York and Connecticut; *Lynd-Farquhar Co.,* Park Square Building, Boston, for Massachusetts, Rhode Island, New Hampshire, Vermont and Maine; *C. H. Briggs Machine Tool Co., Inc.,* Onondaga Hotel, Syracuse, N. Y., for the Syracuse area, and *George Keller Machinery Co.,* 1807 Elmwood Avenue, Buffalo for Western New York State.

◆

LUKENS STEEL COMPANY.—*Dr. William G. Theisinger* has been appointed assistant to the vice-president of the Lukens Steel Company, Coatesville, Pa. *Thomas T. Watson* has been appointed director of research of Lukens Steel and its subsidiaries, By Products Steel Corporation and Lukenweld, Inc., Coatesville. *D. Bruce Johnston* has been appointed assistant to the director of research, and *Samuel D. Lemmon* research metallurgist.

◆

COPPERWELD STEEL COMPANY.—*William M. Ege,* formerly western sales manager, has been appointed general manager of sales of the Copperweld Steel Company to succeed *W. J. McIlvane,* now executive vice-president. *Henry Oberle,* who has been with the Queensborough Gas & Electric Co., has joined Copperweld as eastern sales manager to succeed *Paul Van Wagner,* now vice-president in charge of export sales. *P. A. Terrell* has been transferred from the company's Washington, D. C., office and appointed assistant to the executive vice-president at Glassport, Pa., and *Erich G. Elg* has been appointed western sales manager to succeed Mr. Ege.

◆

TIMKEN ROLLER BEARING COMPANY.—*Donald S. Klippert,* Cleveland, Ohio, district manager of the Timken steel and tube division of the Timken Roller Bearing Company, Canton, Ohio, has been appointed assistant general manager of sales of that division. *Robert P. Donnell,* Timken steel and tube division metallurgical engineer, has been appointed to succeed Mr. Klippert.

GENERAL MOTORS.—The Grand Rapids plant of General Motors, now being operated by the Saginaw Steering Gear division for the manufacture of injectors, has become a permanent division, known as the Diesel Equipment division. Post-war plans for the new division call for the construction of a new plant to meet special problems in the manufacture of injectors. *C. F. Runchey,* manager of the Grand Rapids plant, is general manager of the new division and *C. W. Truxell,* of the engineering staff of the Detroit Engine division, has been appointed chief engineer.

Obituary

RAYMOND D. JENKS, vice-president of the Dominion Brake Shoe Company, Canadian subsidiary of the American Brake Shoe Company, died on December 28.

◆

HENRY G. BURNS, manager of the office of the Buckeye Steel Castings Company at New York since 1913, died November 18. He was 64 years of age. Prior to 1913, Mr. Burns was in the president's office of the New York Central.

◆

RALPH J. DODDS, district manager of the Oxweld Railroad Service Company, a unit of the Union Carbide & Carbon Corporation, died in Chicago on December 8. Mr. Dodds was 45 years of age. He was born in Topeka, Kan., in 1898. He joined the Oxweld Railroad Service Company in 1919 after having had general railroad mechanical and oxyacetylene welding experience, and held the positions of mechanical instructor, district superintendent, and district manager.

R. J. Dodds

◆

LT.-COL. WALTER H. HINSCH, chief engineer of the Dearborn Chemical Company, whose death on November 15 was reported in the December issue, was born at Chicago on December 28, 1895, and studied mechanical engineering at night school. He entered railway service in 1912 with the Chicago & North Western and served as detailer and designer both in the locomotive and car departments. During World War I he served in the U. S. Army, advancing to second lieutenant of field artillery. In 1920 he went with the American Steel Foundries as a designer of freight and passenger car appliances and in 1924 became chief draftsman of the Locomotive Firebox Company. He was later appointed assistant to the mechanical engineer. Mr. Hinsch entered the employ of the Dearborn Chemical Company in 1936 as chief engineer in charge of design and installation of wayside water treatment plants and equipment. After World War I, he retained his commission in the Officers Reserve Corps and re-entered the service on January 15, 1942, as a major in the field artillery, taking a leave of absence from the Dearborn Chemical Company for this purpose. Colonel Hinsch was killed during maneuvers at Camp Van Dorn, Miss., on November 15, by the accidental discharge of a shell from a field mortar.

Merrill Chase Studios

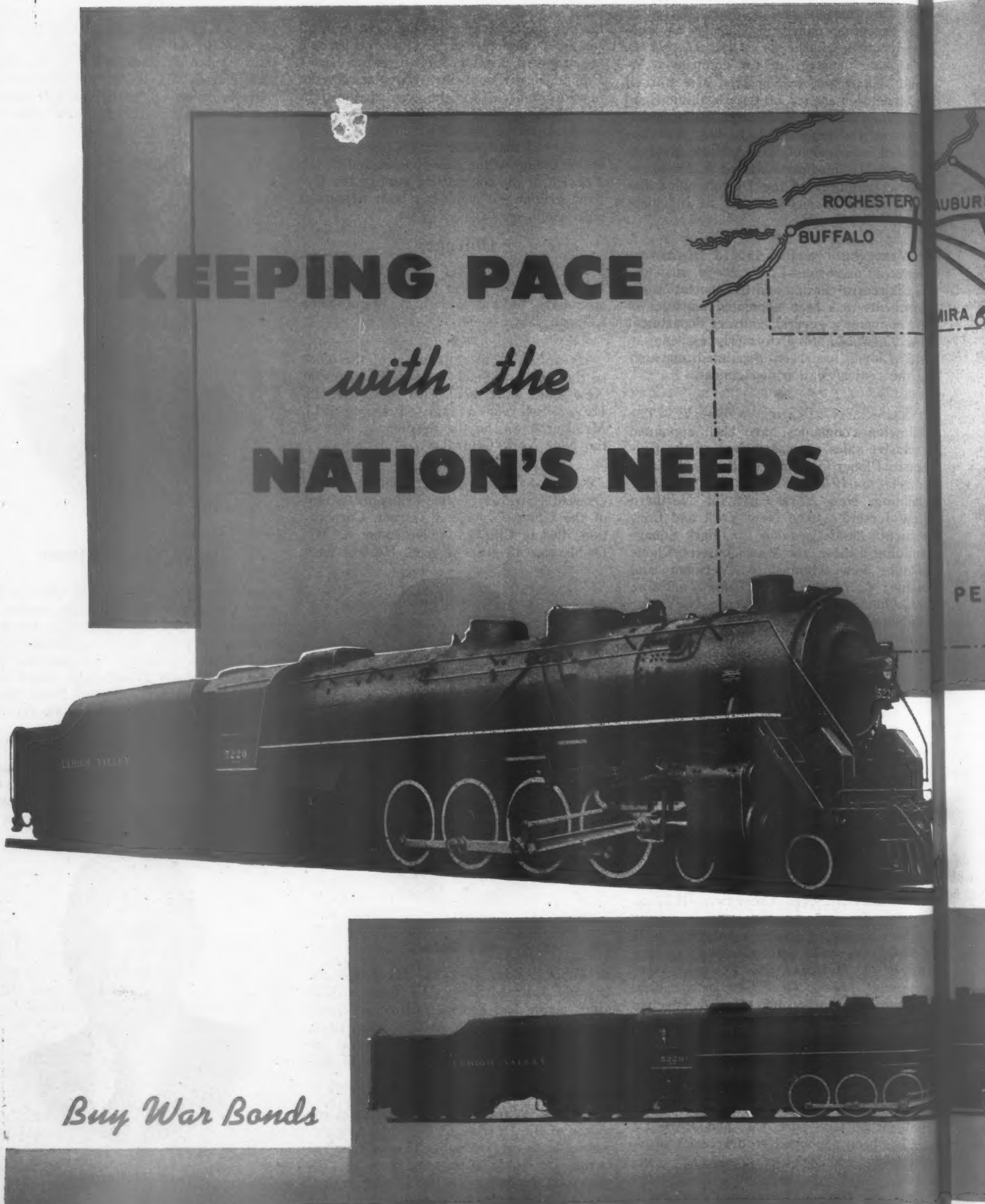
Lt.-Col. Walter H. Hinsch

◆

STEWART MCNAUGHTON, sales manager in charge of steam locomotive sales of the Baldwin Locomotive Works, died December 14. Mr. McNaughton was 61 years of age. He joined the Baldwin Locomotive Works in 1899 as a mechanical draftsman and devoted his attention to various phases of locomotive design and engineering for the next 15 years. In 1915 he entered the sales department as manager of locomotive repair parts activities. He assumed charge of all steam locomotive sales in 1941.

Stewart McNaughton

(Turn to second left-hand page)


KEEPING PACE
with the
NATION'S NEEDS
ROCHESTER
BUFFALO
LEHIGH VALLEY
Buy War Bonds

Personal Mention

General

H. F. FINNEMORE has been appointed assistant chief electrical engineer of the Canadian National.

GEORGE LESLIE DICKSON, electrical and signal engineer of the Atlantic Region, Canadian National, with headquarters at Moncton, N. B., has retired.

L. W. DOGGETT has been appointed mechanical engineer of the Virginian, with headquarters at Princeton, W. Va.

JOHN HILLYARD MCALPINE, superintendent of motive power and car equipment of the Montreal district of the Canadian National at Montreal, Que., has retired.

WILFRED CHARLES BOWRA, assistant superintendent of motive power and car equipment of the Montreal district of the Canadian National at Montreal, Que., has been appointed superintendent of motive power and car equipment of that district

Wilfred Charles Bowra

with headquarters at Montreal. Mr. Bowra was born and educated at Stratford, Ont., where he began his railroad career as a machinist apprentice in the motive-power shops of the Canadian National. During his apprenticeship he completed courses in mechanical drawing and mathematics at Stratford Collegiate Institute. After working as an apprentice, he was appointed inspector of motive power and car equipment at Toronto, Ont., in September, 1937, and assistant test engineer the following year. In October, 1939, Mr. Bowra became locomotive and car foreman at Cochrane, Ont., later serving as locomotive foreman at Mimico, Ont., and Turcot enginehouse, Montreal. Last May he was appointed assistant superintendent of motive power and car equipment.

WINSBY WALKER, who has been appointed superintendent motive power and car shops, Atlantic Region, of the Canadian National at Moncton, N. B., as announced in the October issue, was born on May 30, 1897, at Darlington, England. He attended Darlington Council Schools from 1902 until 1910, and Bondgate Higher Grade School from 1910 until 1913. He became an apprentice machinist in the employ of the Grand Trunk Railway on October 17, 1913, and in January, 1916, enlisted for active service with the Canadian Field Artillery.

Winsby Walker

He proceeded overseas in February, 1916, and saw service in France from March, 1917, to February, 1919. He returned to Canada in March, 1919, and completed his apprenticeship in 1921. He worked as a machinist until 1930 when he was appointed locomotive inspector on new construction. He became machinist leading hand in February, 1935; assistant foreman in April, 1935; locomotive inspector at the Canadian Locomotive Company, Kingston, Ont., for the Canadian National in September, 1935; erecting shop foreman at Point St. Charles (Montreal) shops in December, 1936, and general foreman at Point St. Charles in March, 1937. Mr. Walker was appointed superintendent motive power and car shops at Moncton on June 20, 1943.

Master Mechanics and Road Foremen

F. J. TOPPING, master mechanic of the Chesapeake & Ohio at Hinton, W. Va., has been transferred to the Hocking division, with headquarters at Columbus, Ohio.

F. R. BUTLER, general foreman of the Chesapeake & Ohio at Lexington, Ky., has been appointed master mechanic of the Ashland division, with headquarters at Ashland, Ky.

J. P. FRANCIS, enginehouse foreman of the Eastern Region of Pennsylvania, has been appointed assistant master mechanic of the Eastern division, with headquarters at Conway, Pa.

G. R. WEAVER, foreman-marine of the Delmarva division of the Pennsylvania, has been appointed assistant master mechanic of the Pittsburgh division.

A. B. SHANKS, general master mechanic of the Missouri-Kansas-Texas, with headquarters at Denison, Tex., has retired.

L. J. GARRETT, enginehouse foreman of the Pennsylvania at East Altoona, Pa., has been appointed assistant master mechanic of the Middle division.

JOHN W. CHAPMAN, assistant master mechanic of the Northern district of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has been appointed general master mechanic with jurisdiction over the Texas lines, the Northwestern district and the Beaver, Neabe & Englewood (part of the M-K-T), with headquarters at Denison, Tex.

M. H. LINGENFELTER, assistant master mechanic of the Northern division of the Pennsylvania, has been appointed assistant master mechanic of the Pittsburgh division, with headquarters at Conemaugh, Pa.

Shop and Enginehouse

R. A. CULBERTSON has been appointed general master boilermaker of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

WILLIAM D. MAJOR, machinist gang foreman of the Atchison, Topeka & Santa Fe at Ft. Madison, Iowa, has been promoted to general materials inspector, with headquarters at Chicago.

C. A. STORCK, gang foreman, Eastern division, of the Pennsylvania, has been appointed assistant enginehouse foreman of the Eastern division, with headquarters at Canton, Ohio.

Obituary

J. THEODORE SODERBERG, assistant mechanical engineer of the Pennsylvania with headquarters at Philadelphia, Pa., died in Bryn Mawr, Pa., on December 9. He was 52 years old.

JOHN B. NEISH, superintendent of motive power of the Northern Pacific, with headquarters at St. Paul, Minn., died at his home in that city on December 19. Mr. Neish was born in Dundee, Scotland, on November 26, 1874, and entered railway service on May 24, 1895, as a machinist in the employ of the Northern Pacific at Sprague, Wash., later serving as a machinist at South Tacoma, Wash., and Spokane. On March 1, 1904, he was promoted to the position of enginehouse foreman, and on December 1, 1910, was appointed master mechanic, with headquarters at Minneapolis, Minn. In September, 1915, Mr. Neish was transferred to St. Paul and on November 1, 1929, he became general master mechanic of the Western district, with headquarters at Seattle, Wash. On December 1, 1939, he was appointed mechanical superintendent and on July 15, 1941, superintendent of motive power.

ANDERSON Eitherend

WELDING CABLE CONNECTORS

For convenience in electric welding, Anderson Eitherend cable connectors provide a simple means for coupling together lengths of single conductor cable. Neither male nor female, just insert one connector within the other and the juncture is complete. The ends are exactly alike and no mistake can be made. Eitherend cable connectors have no bolts or other loose parts that take time to adjust.

Thousands in daily use all over the country. Made in cable sizes from No. 6 to N0. 0000. Soldered or solderless connection.

TYPE CC Receptacle. The standard passenger car charging receptacle for many years.

ALBERT and J.M. **ANDERSON** MFG. CO.

289-305 A Street, Boston 10, Mass.

NEW YORK **CHICAGO** **PHILADELPHIA** **LONDON**

production men

See that kid in uniform? It's his first morning home. He's finished with his job of fighting a war. Now there is peace. But can it be peace if this kid—yours, perhaps—and millions more like him, face a "no help wanted" future? American business has the answer. It's sales. Sales make jobs. Production must promote sales . . . by making it better, faster, in greater quantity for less money, for more people. How about your productive "sales promotion" equipment? Your lathes, for instance? Will they turn to the tempo of *lowest cost* post war production? A "maybe" answer won't do. The boys coming back have a heritage coming due. It is largely up to "heir" minded production men to see that they get it . . . the opportunity to earn an honest living by honest work in support of the *real* American standard of life.

MEMO: *U. S. Department of Commerce predicts that if the war lasts through 1944, Americans will have accumulated savings amounting to $100,000,000,000. Be prepared for mass marketing. From now on business must reckon with huge masses of buyers.*

THE R.K. Le BLOND MACHINE TOOL CO., CINCINNATI, 8

NEW YORK 13, 103 Lafayette St. CAnal 6-5281

CHICAGO 6, 20 N. Wacker Dr. STA 5561

Check·Clip·Mail

FOR ILLUSTRATED SPECIFICATIONS:

- ☐ HEAVY DUTY GEARED HEAD ENGINE LATHES
- ☐ TOOL ROOM LATHES
- ☐ AUTOMATIC LATHES
- ☐ HEAVY DUTY GEARED HEAD GAP LATHES
- ☐ SUPER REGAL GEARED HEAD LATHES
- ☐ RAPID PRODUCTION LATHES
- ☐ AUTOMATIC CRANKSHAFT LATHES
- ☐ No. 2 CUTTER GRINDER

YOUR NAME________ TITLE____

YOUR FIRM________ ADDRESS____

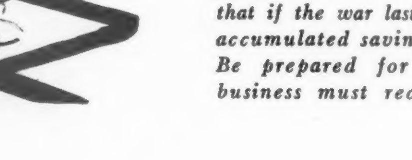
ARMY E NAVY

LE BLOND

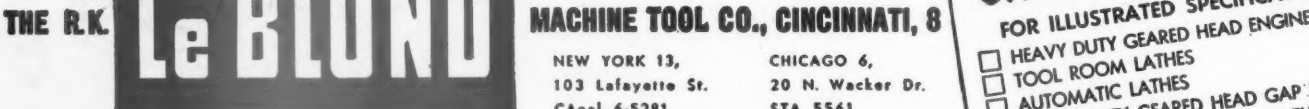
time to retool

Turn to Le Blond for Turning Equipment

LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES



★ YOUR BONDS BUY BOMBS ★
BUY A "BLOCK-BUSTER" TODAY!



HD Engine Lathes—Nine sizes ranging from 12" to 50" swings. For versatility in turning.

Automatic Lathes—12" & 16" Mechanical or Hydraulic power.

Super Regal Lathes—Six sizes, 13" to 24" Best for training.

Automatic Crankshaft Lathes—For all facing, turning, finishing, pins.

Tool Room Lathes—12", 14", 16" and 18" swings. Versatile.

HD Gap Lathes—Ten sizes in Regular and Sliding Gap models.

Rapid Production Lathes—13", 17", 20" swings. Six speeds. Faster output. Lower cost.

No. 2 Cutter Grinder—Internal, cylindrical, face and angular work.